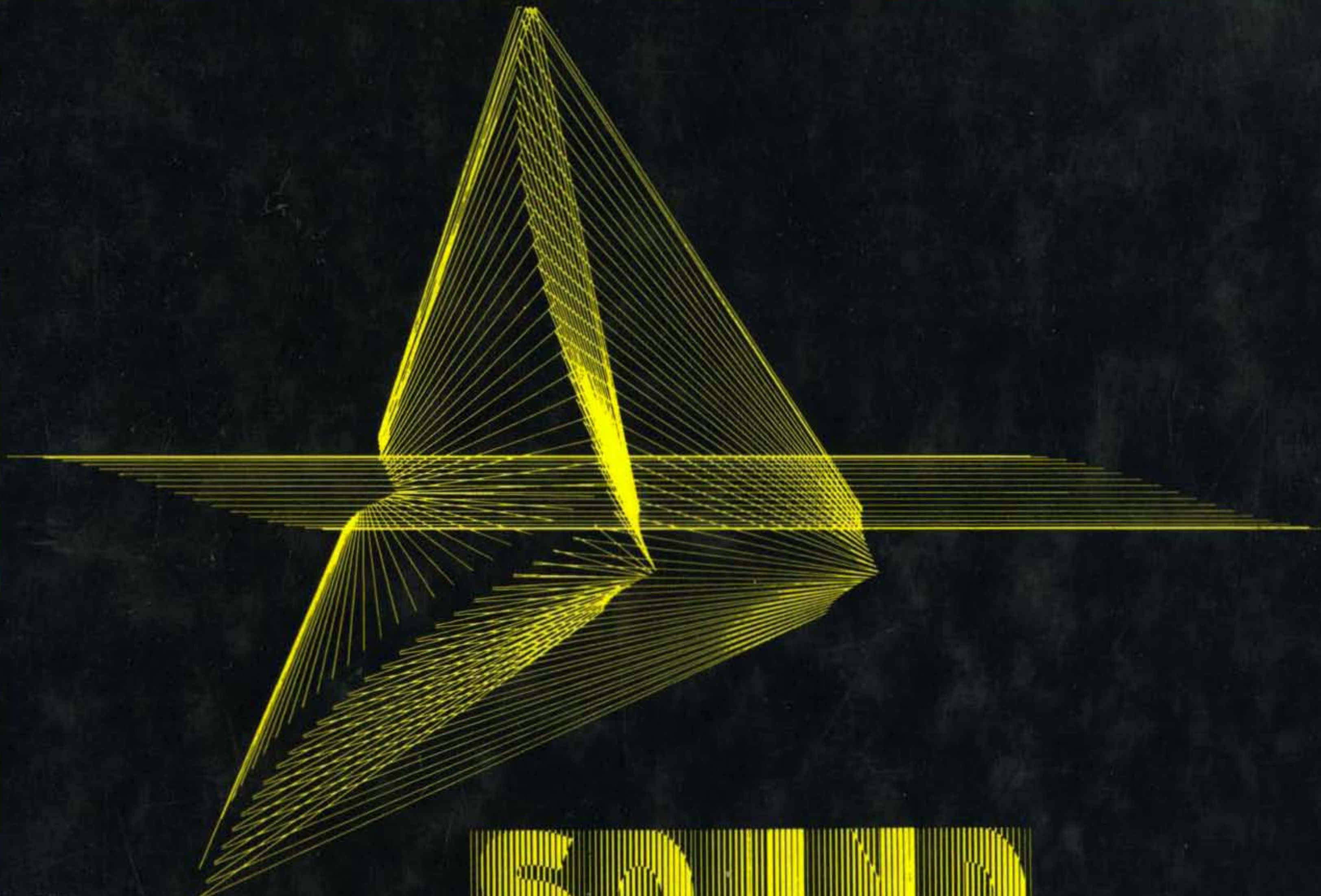

SOUND SCULPTURE

SOUND SCULPTURE

a collection of essays by artists
surveying the techniques; applications;
and future directions of sound sculpture.

John Grayson

editor

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Doris Shadbolt and Tony Emery of the Vancouver Art Gallery were instrumental in supporting the exhibit of Sound Sculpture which involved most of the artists described in this book.

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John Grayson,

Duncan, B.C.

A Note

A stereo LP featuring the sounds of many of the Sound Sculptors described in this book will soon be issued by ARC Press in Vancouver. Write for further information.

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ABOUT THE AUTHOR

John Grayson is a sound sculptor, university lecturer, experimental theatre producer, and farmer. He also occasionally produces television programs for the Canadian Broadcasting Corporation. Over the years he has organized and conducted numerous workshops, seminars, international conferences and exhibitions for a diverse range of institutions in such areas as: the theatre arts; perceptual awareness; computer art systems; sound sculpture; expanded music systems; and various facets of music education. He is currently the Managing Director of the Aesthetic Research Centre of Canada.

Foreword

This publication attempts to present as forthrightly and practically as possible the wide range of multi-levelled information necessary for the serious student's understanding of the varied processes and skills involved in sound sculpture. At the same time it is intended to acquaint the general reader with the full range of the multi-faceted world of sound sculpture.

It is divided into four parts. The first is devoted to the majority of the senior artists active in the field of sound sculpture and consists, as does the remainder of the book, of articles and illustrative material largely written or compiled by the artists themselves.

Part II consists of a series of diverse essays and articles by distinguished senior artists of strong interdisciplinary background which serve to provide a lattice work of those heritages integral to the field of sound sculpture.

We can be sure that future developments which involve the integration of visual form and beauty with magical, musical sounds through participatory experience (in essence: sound sculpture) will take place which will more completely involve the various energy/perceptual systems of man. A different kind of sound sculpture is developing. Part III centres on this.

Part IV presents descriptions of innovative and creative applications of everyday, readily available materials for the creation of sound sculpture. This section when coupled with the information provided in the extensive references given at the end of the book will allow even a back-porch hobbyist sound sculptor to begin many interesting projects on his own.

The information provided in this book can be further supplemented by viewing various color and black and white video tapes which depict many of the artists and their works "in performance". These various tapes are available on loan. For further information write: Video Library, Vancouver Art Gallery, 1145 W. Georgia St., Vancouver, B.C., Canada, V6E 3H2.

Ed.

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PART IV: PRACTICAL PROJECTS & POSSIBILITIES

THE BASCHETS

Francois Baschet was born in Paris in 1920. He was trained by sculptors Emmanuel Auricoste and Hubert Yencesse, and studied acoustics on his own. He lives in the Spanish Basque country, where he works, and in Paris. His brother, Bernard, was born in Paris in 1917. He studied engineering at the Ecole Centrale and was the former chief of musical research for the French Broadcasting System. He lives near Paris.

In 1952 the Baschet brothers began their researches into sound with an analysis of all existing instruments. Since then, they have built dozens of unique musical sculptures. Recently the Baschets have been building a wide variety of sound sculptures designed to be played by anyone, young and old alike. They have been steadily moving toward a non-exclusive, totally participatory, people's art.

In 1968 Bernard Baschet wrote an eight part essay in French which appeared in 'Leonardo, Journal of the International Contemporary Artist.' Five parts of this essay now follow in their first English translation.

Structures Sonores

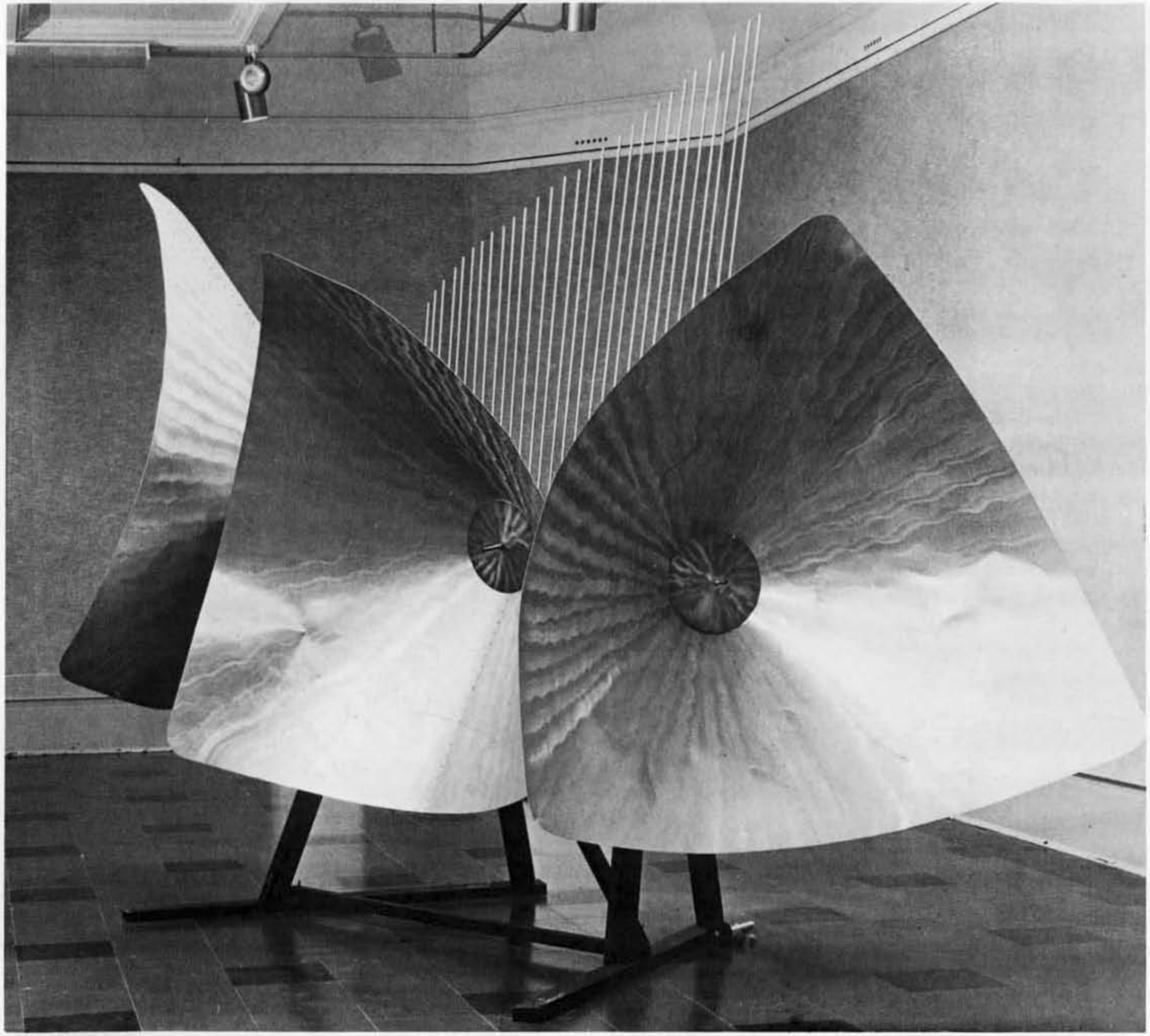
by Bernard Baschet

ABSTRACT

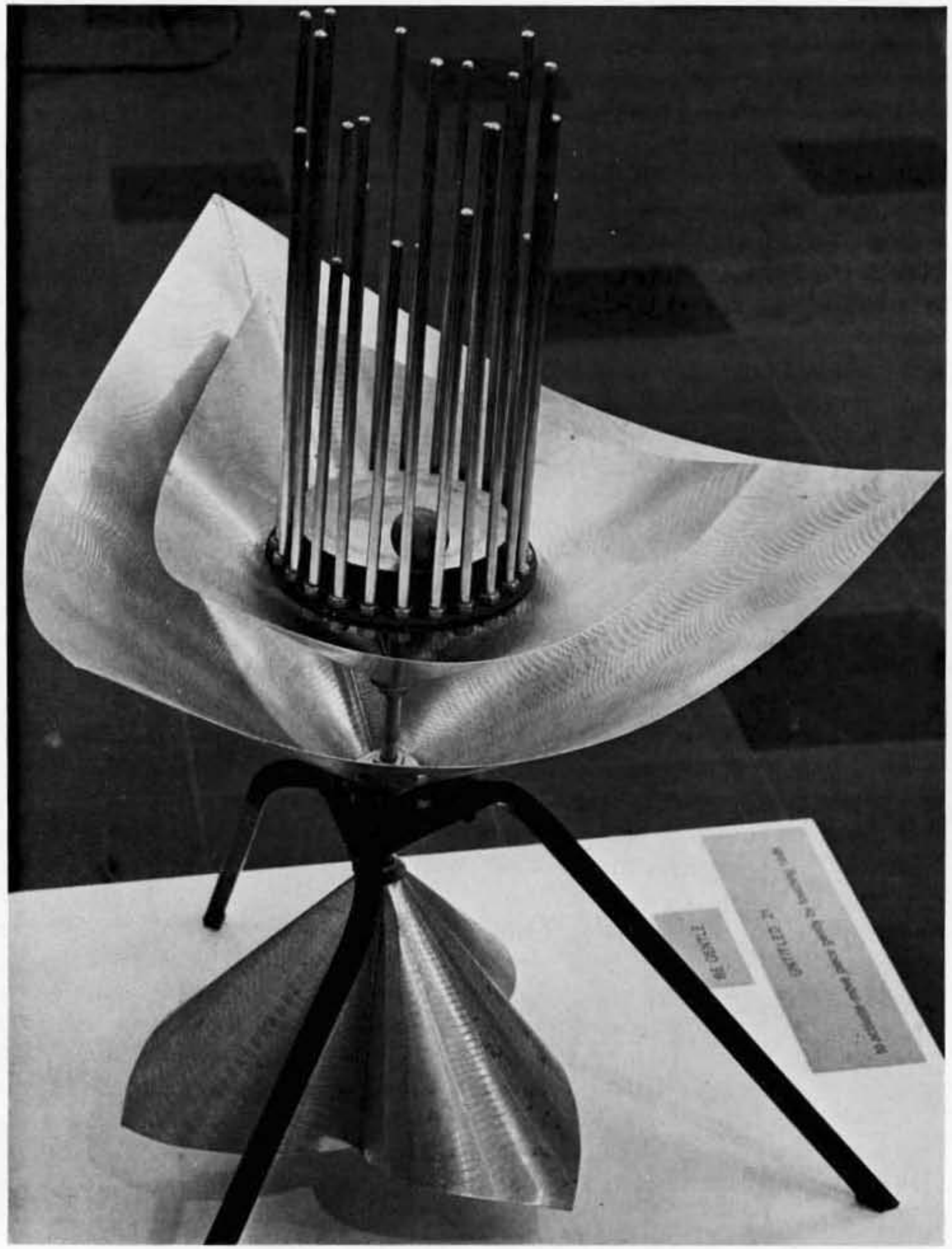
If art and love are similar, art should be understandable without any explanation; the 'Sonorous Structures' made by the Baschet brothers should be understood without analysing their components, or the impulses of their creation. Nevertheless, their process of research, creation, execution is of interest.

The members of the team possess several qualifications in the fields of music, sculpture, poetry and play production, however the leading idea of the team is research for creating sounds and shapes.

Once a way of producing sound is found, appropriate shape is required for the device: the 'musical sculpture-object' can be considered either as a musical instrument, as an instrument easy to play, as a 'sculpture-object' for which sound is only complementary, or even as the starting point for working with materials.



French Monument Born on 57th St.
steel, aluminum
13 x 6 x 8 feet



Untitled No. 21
aluminum, steel
27 x 18 x 18 inches

Then comes the problem of choosing the means of communication in such a way that a message is both understandable and original. All the work of the team is directed towards the finding of a new musical expression. On the assumption that a playing instinct is possessed by everyone, members of an audience are invited to try their hand at playing these instuments.

The work of the team is directed to a search for harmony, in the sense of harmony between shapes, sounds, sculpture, music, light, poetry and motion – a harmony for a new generation.

INTRODUCTION

The contemporary artist seeks to "discover" the relationship that exists between modern man and the modern "object", i.e., the external world of technological activity.

He must assimilate and make a part of himself the new things which bombard him: shapes, sounds, mechanical gadgets, etc. and project them "humanized," if I may use the expression, into his works.

In technological activity, the materials are assembled according to a structure characteristic of their physical properties and are easily grasped by the intellect. The laws, in this case, are already determined. Art trys to assemble the materials according to a structure internal to us. Perhaps it is the structure of the images of these materials which we seek in ourselves? This concept calls in emotion, which is entirely excluded if we are speaking of technological activity.

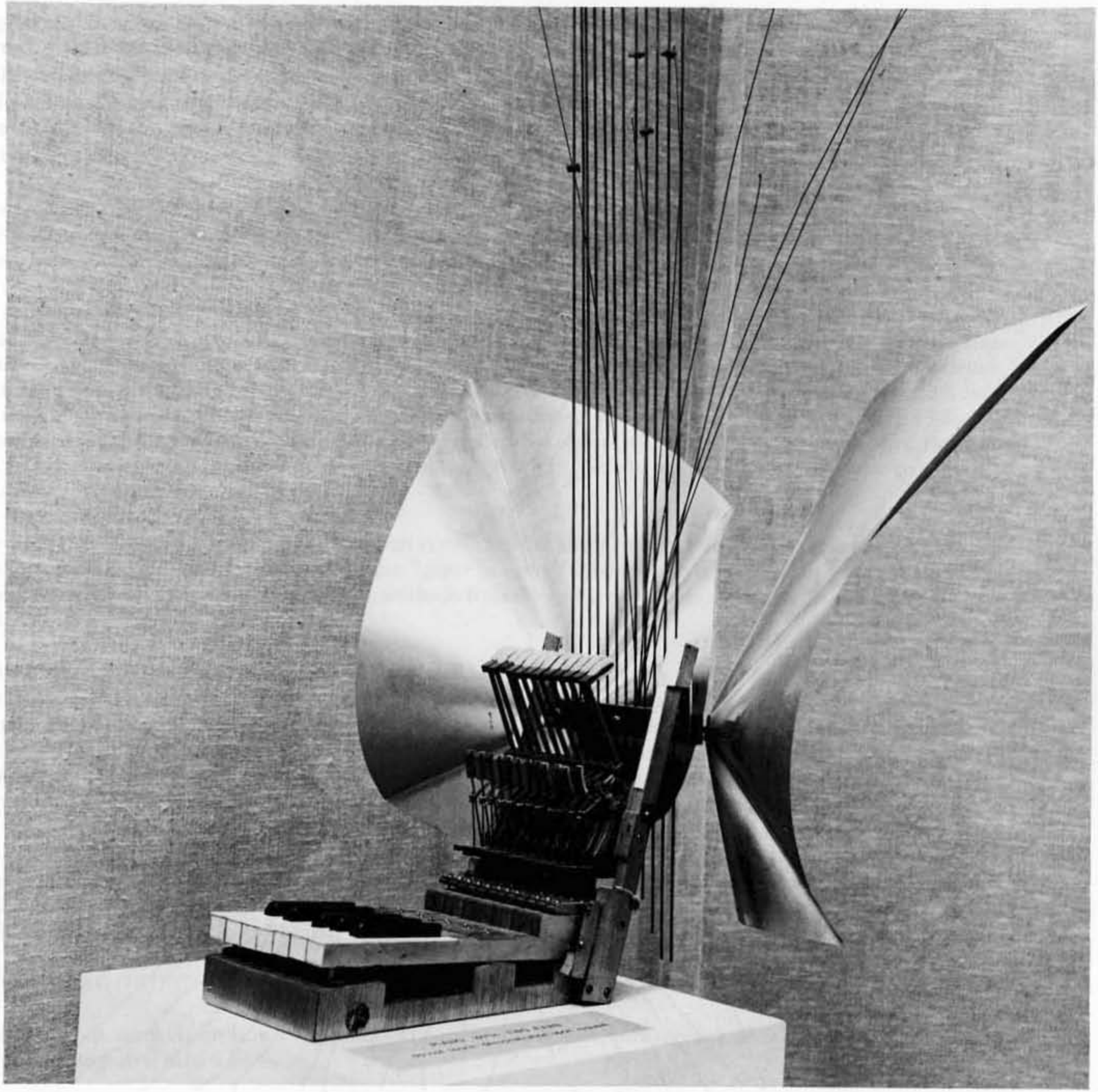
The success comes, I believe, in discovering the structures which coincide. In short, to seek a certain order which coincides in the space without and the space within.

Souriau, in 'Leonardo'[1] writes: "so many artists today, and this is yet another of the striking traits of the present times, are neither sculptors, musicians, nor poets (nor both at the same time), but search for new means of expression which do not enter into any of the forms which have long stereotyped the traditional artistic activity."

Likewise, I find this other observation exact: "Contemporary artists are seekers."

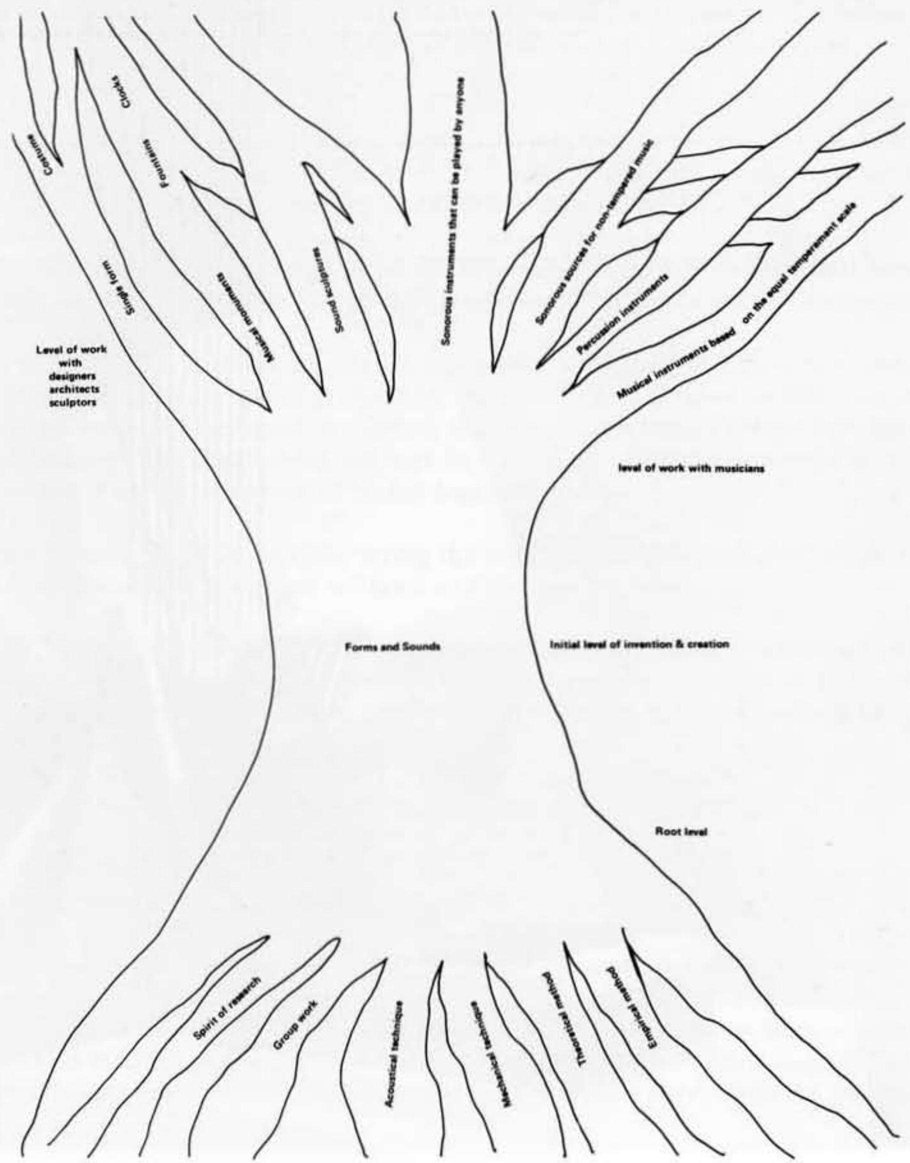
We feel profoundly that we are all of these: seekers, musicians, sculptors, poets, but also craftsmen and stage directors. All of this is what constitutes our daily work.

We are musicians because we are performers and play in concert; sculptors because with our hands we shape sheets of metal into forms, and assemble iron and other metals; poets, because we attempt to create the "supernatural element" – a universe of light, shape and sound; craftsmen, because with our hands we build musical instruments, referring also to our sensoriality; stage directors because we have staged productions where music, lighting effects, and shapes enter with the participation of actors, dancers . . .



Piano with Two Ears
wood, steel, iron, aluminum alloy
48 x 27 inches

The activity of the "Baschet Brothers" can be schematized by the tree in the figure below. The roots are the base our knowledge where the sap originates. The branches hold the fruit – our works. These are the directions of work: on the right those which concern sounds, and on the left, those which concern the forms. Of course there is constant communication between all the branches. The trunk represents the essential in our work: the creation and invention of the sounds and the forms.[2-16]



Scheme of the activity of the
Baschet brothers

MUSICAL STRUCTURES INTENDED FOR THE GENERAL PUBLIC

The branch of activity which involves putting the musical instruments at the public's disposal stems from an observation first made following our concerts. At the end of such concerts, we invite members of the audience to come up on stage so that they may speak to us if they wish to, and examine our instruments.

Generally speaking, there are as many people on stage as can be accommodated, and we must protect the instruments from the eagerness of the curious who, while shy at first, let themselves become carried away by their own sonorous discoveries.

At our exposition of Decorative Arts at the Marsan Pavilion in 1964, we had thus provided a room for that purpose—an idea which was used again at our later expositions in the Scandinavian countries, Germany, England, the United States and Mexico. The pleasure and freedom felt through this experience generally depends upon age and natural artistic ability, but we have seen older people who, with a look of delight on their faces, literally lose all of their inhibitions. The reserve and timidity which exists when one faces the keyboard of a piano for example, disappears. Everything being unknown, there are no teachers to give advice or to point out mistakes. We say 'Go ahead, nobody knows how to play it, discover for yourselves!'

We have discovered how much modern man conserves the taste for, and no doubt the need for creating his own sounds and his own rhythms. The "game playing" instinct exists in all of us. This tendency towards the public participating in such works is found everywhere in modern art, from Calder to Kinetics.

Works of art are not simply valuable objects which on one hand carry a price tag, and, on the other hand, bear a "Do Not Touch" sign; on the contrary, they are to be played with, and one should approach them not only with the eyes and the ears, but with the hands as well. Art becomes once again a social function. It is an area where the freedom to touch for pleasure, and for understanding exists, not only for the privileged few, but for everyone, just as nature has always been for children living in the country. In the area of technology, which has in a sense invaded our modern life, there is no place for fantasy, games, or touching. At the present, however, these are the essential elements of life.

For us, this line of work serves as a sort of "testing bench". But, we have no need to arrange complicated keyboards—the first condition is that they be easy to play. It is essential that the instrument be solid and resistant to the punishment it receives from classes of 12-year-old children.

SCULPTURE-OBJECTS

The sonorous mechanism is not the essential part of the object, but serves rather as a framework which must be integrated into a form.

The search for radiators or sound diffusers has led us to use uniform (reglees) surfaces. We then had to bend the surfaces into the shape of a cone, and, according to the metal, the shape and the curvature, we obtain different sounds. After that, we conducted a number of experiments which have produced the required shapes.

In general, we merely bend the sheet of metal, working only with simple geometric forms. As in our musical experiments where one allows himself to be carried away by the sounds, we have followed the same procedure with the sheet metal. Almost all of our forms are made directly by bending a sheet of metal with our hands. The sonorous mechanism itself is always the fruit of the intellect. In this respect, our hands are more creative than our brains, or at least it may be possible that their scopes are not the same. I think that all artists have the same problem to solve: to make their hands, their brain and their soul live together freely and in harmony like three members of the same family.

But, not all of our sonorous objects are comprised of metal sheets molded into shapes. The whole object, which often has an architectural appearance, could be constructed of vibrating elements only. In fact, the distinction between the sonorous sculpture and instruments at the public's disposal is a bit theoretical, the result being in both cases the satisfaction of the eye and the ear.

In this field, the idea of working in groups has also intervened. Francois is at the base of this development, on one hand because of his disconcerting inventive fertility, and on the other hand because of his training and vocation as a sculptor. I myself am more interested by the architectural and compositional aspects of the work due to my training as an engineer and my experience as a composer.

This teamwork is thus at a level where the brainwork of one is realized by another. An important addition to the team is Xavier de la Salle, a sculptor and painter who has collaborated in the production of monuments and the Dress-forms. Francoise Burtz, nicknamed "Colibri" has for years given us a great deal of help and that which is perhaps more important in the long run – her "presence."

The sonorous sculptures are obviously commissioned: for a school, a sculpture-instrument which the children will be able to practise upon; to enliven the centre of a group of dwellings at Reuil, a tower-clock sculpture; for an exposition in San Antonio, Texas, a musical fountain (cf. p. 10).

CREATIVE METHOD

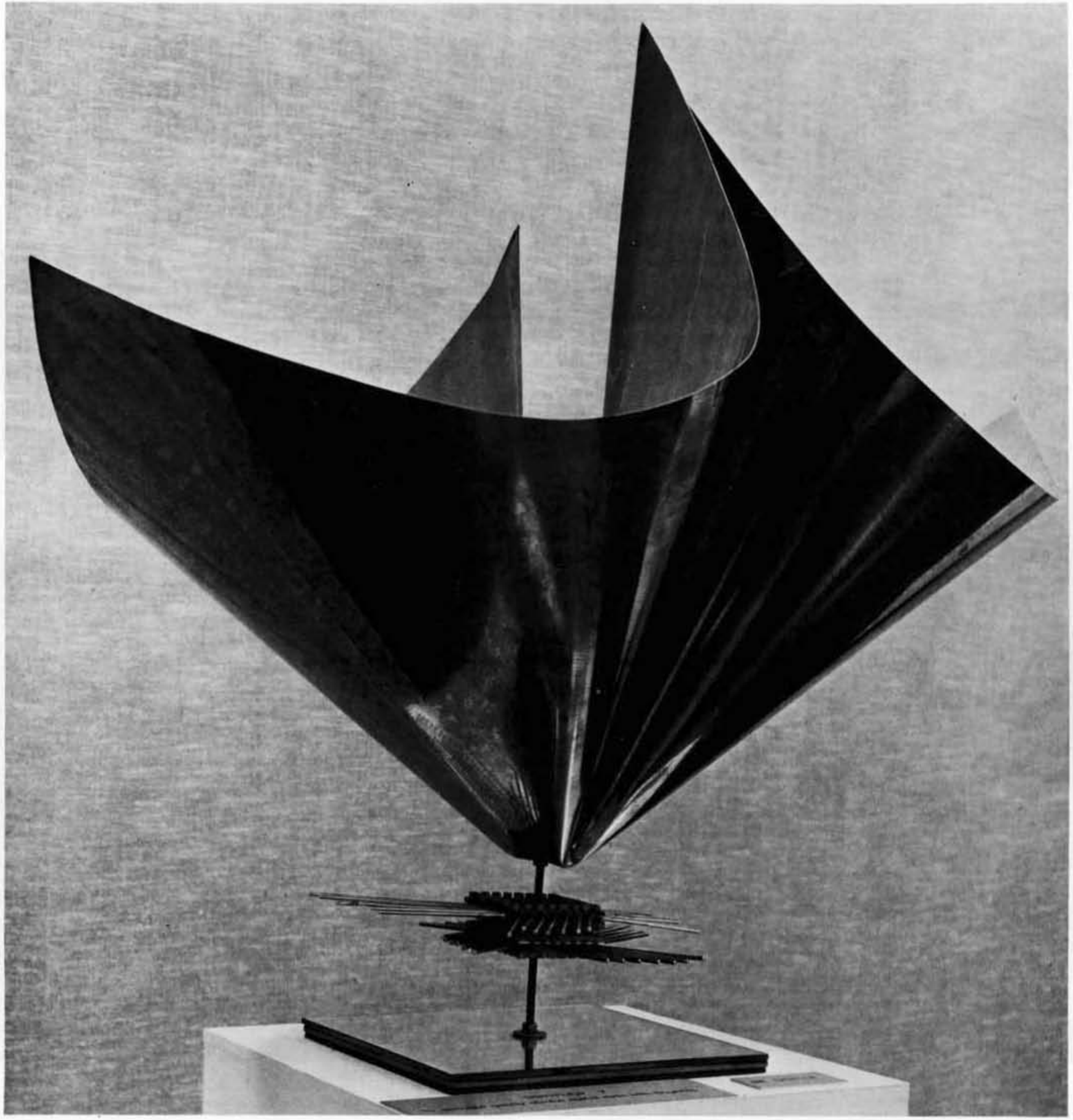
In our work, there is an alternation of methods and attitudes in regard to certain problems which must be solved.

The first method is empiricism. It is the hands which discover and the completely unconditioned ear which listens attentively. Very few designs are used for the shapes – it is the material itself which determines its ultimate form (many other sculptors have said this before us). For the music, it is group improvisation which provides the new and the unexpected – improvisation which is, in fact, a series of successive attempts, much like an advance through an unfamiliar forest: step by step.

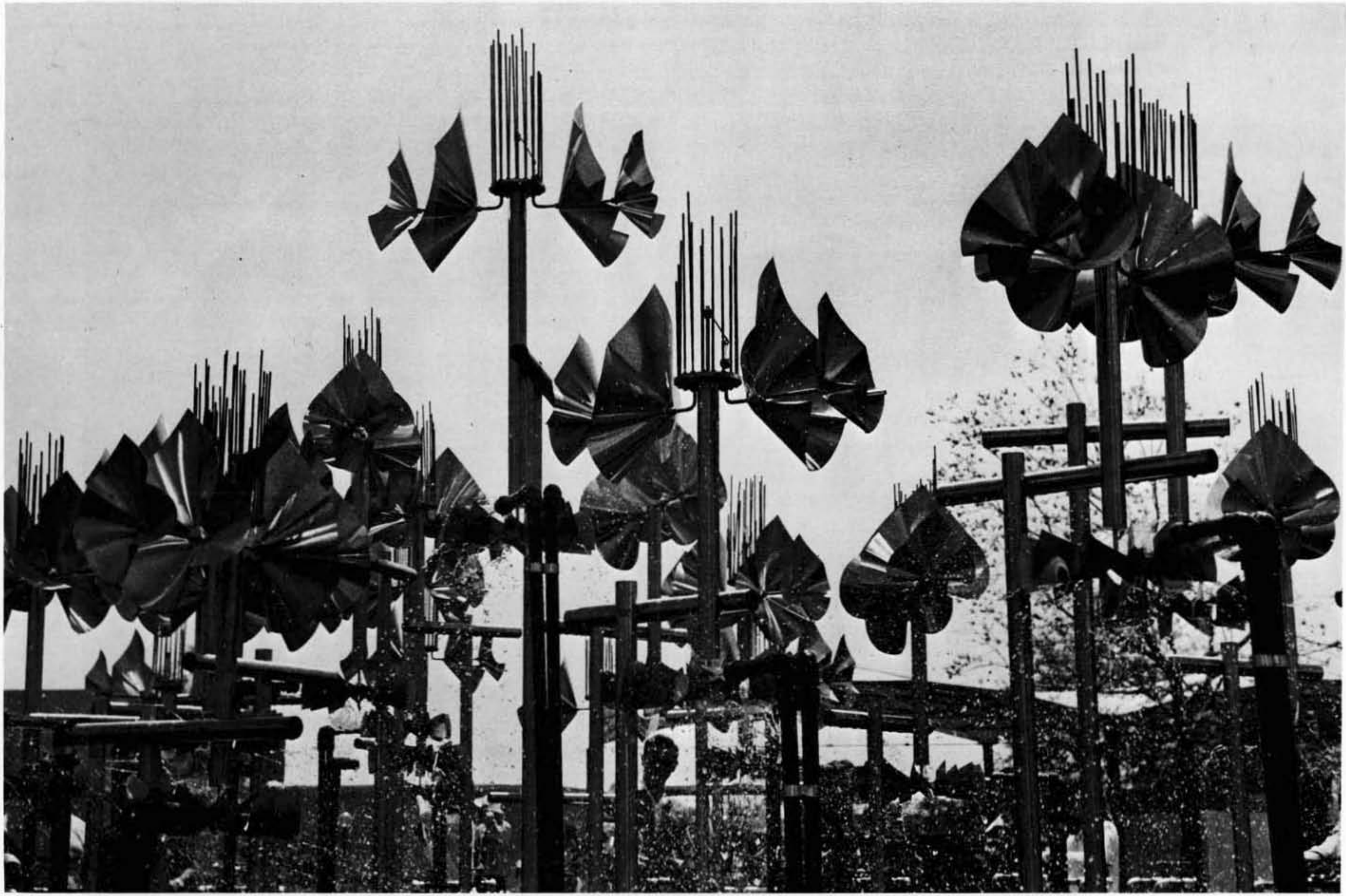
"Primitive man found magical sounds in the materials around him – in a reed, a piece of bamboo, a particular piece of wood held in a certain way, or a skin stretched over a gourd or a tortoise shell – some resonating body. He then proceeded to make the object, the vehicle, the instrument, as visually beautiful as he could. His last step was almost automatic. The metamorphosis of the magical sounds and the visual beauty into something spiritual. They became fused with his everyday words and experience: his ritual, drama, religion – thus lending greater meaning to his life. These acts of primitive man become the trinity of this work: magical sounds – visual form and beauty – experienced ritual."

Harry Partch, 1967


François Baschet



Untitled No. 7
stainless steel
35 x 48 x 22 inches



Hemisfair Musical Fountain

Our second method was chosen when, after having discovered the possibility of creating sound by the process described above, we decided to make musical instruments. The method of perfecting existing instruments could not be utilised, for it generally gave poor results. We have made the following analysis–an instrument can be decomposed in this manner:

a) an excitatory (stimulating) element;
b) a vibrating element;
c) a resonant element, which produces the tones;
d) a element which radiates through the air (coupling);
between (b) and (c), we are introducing a new sound collecting element.

We have drawn up a table of possibilities of each element found scattered about in acoustic experiences. Then, we have re-synthesized the elements which interested us.

It is in this manner that we have succeeded in creating at the first attempt the ancestors of a whole family of instruments – the equivalents of the clavichord and the vio da gamba (members of the family of stringed instruments).

This formula allows us to stand back and consider our difficulties, and thus be able to introduce completely new solutions. It is this method which has given the modern world its astonishing machine-tools for public works, the fantastic spatial forms for sidereal expositions . . . this whole world of new images, unthinkable fifty years ago. This is not an art of transition, but rather an art of mutation.

CONCLUSION

People often ask us what correspondence we find between shapes and sounds, because we work with both. If such a correspondence does exist, it is found only at the level of a certain style and qualitative value of inspiration which we cannot perceive. In fact, this music-image problem is present at the level of a correspondence between the two by association. People tend to associate certain sounds with certain objects through conditioned reflexes. In fact, Radio, Television, and the Film Industry often use our music to enhance the effectiveness of underwater scenes, science-fiction films, voyages in space, etc. This association can be due only to a chronological concordance – new sounds for new images.

We ourselves have tried out this sort of association in our presentations where our instruments are used as the decor. With certain lighting effects, we have tried to create, in accordance with the music, a world of fantasy.

Right from the beginning we have been working with dancers, the instruments themselves becoming as much a dancing element as a musical accompaniment. Poetry fits beautifully with our music, which enhances it without overpowering it (this has given rise to several recordings). These same types of artistic experiments have been carried out in the Scandinavian countries and Mexico in the individual styles of each.

I have tried to elucidate in this article all the problems which we must face and the manner in which we have solved them up to the present. Our problems are also those of our generation, and it is with the knowledge and means of our era that we attempt to solve them.

In response to the question which is always asked of us, 'What are you getting at?,' I say quite simply that I believe apple trees produce apples. If they don't, then they are sick. We feel in full health when one of the works which is, in effect, a part of ourselves leaves the work-room.

In actual fact, we instinctively search for the harmony which exists between shape, sound, sculpture, light, poetry, music . . . , but is it not first necessary that this harmony exist in ourselves before we are able to realize it?

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Structures Sonores & Future

by Francois Baschet

My brother Bernard and I want to make a synthesis of the following three elements:

shapes
sounds
public participation

We make shapes and objects with which music can be produced manually – is without electricity or electronics. Therefore anyone can play on them.

Beginnings in 1954 were difficult. Sacha Guitry said: 'My wife wants dinner at 7. I want it at 8. We end up by eating at 7.30 and nobody is happy.'

In our attempts to synthesize new form and new sound we encountered similar comments. Music people said 'this is no music.' Sculpture people said 'this is no sculpture.'

Things have improved. After our show at the Museum of Modern Art in New York which lasted for four months it is easier for us to see the future.

Shapes: Acoustical laws are precise – some families of shapes are good, some are bad. We have to develop metal or plastic surfaces that can be compared to sails. To get a satisfactory acoustical ratio, some of these surfaces must be suspended. This means that we have to find the right equilibrium in our designs. The structures also have to be strong, some of them have been played on by more than 150,000 people including children. Thus we try to combine the aesthetic with the functional.

Sounds: Possibilities in relating sound to form are immense. So far it is the architects that have been most interested in our researches. At the moment we are working on a musical monument for a school near Paris. It will assume the form of a giant vibraphone that will replace the bell. It will play a tune composed by the best pupil of the musical class, which will be changed periodically. Francois Prieur is the architect.

Another U. S. architect wanted us to make a big 'conversation piece' for a shopping centre. We proposed a musical fountain with both the sound and water jets controlled by the public. The chords would be carefully programmed so that the sounds would not be offensive. We proposed recently to a grain company that we should make a musical fountain with grain falling from the ceiling filling oscillating buckets. When full, the buckets would tilt and hit vibrating bars. The grain would be returned to the original position by a conveyor belt. A section of this project is now at the New York University Museum. For their 200th anniversary the Baccarat crystal plant company commissioned us to make a 12 x 12-foot monument that would essentially convey the sound of crystal. These few examples indicate that the possibilities of using non-electronic sounds in architecture are immense. We have only explored a few possibilities so far.

Music: After the big vogue for electronic music of the past 15 years, many musicians seem to come back to manually produced sounds. The instruments we have been developing with Jacques and Yvonne Lasry since 1954 present real possibilities. This year the Lasrys are holding summer courses in Burgundy in the use of the instruments. Moreover, if one thinks of the conventional orchestral instruments, with the exception of the wind instruments, only the violin is perfect. Harps, guitars, can be redesigned. The grand piano is a heavy musical wheelbarrow. The piano of the future is not yet born.

Technical: We were surprised to have been approached by people in very different fields. We have been asked, for instance, to make educational musical devices.

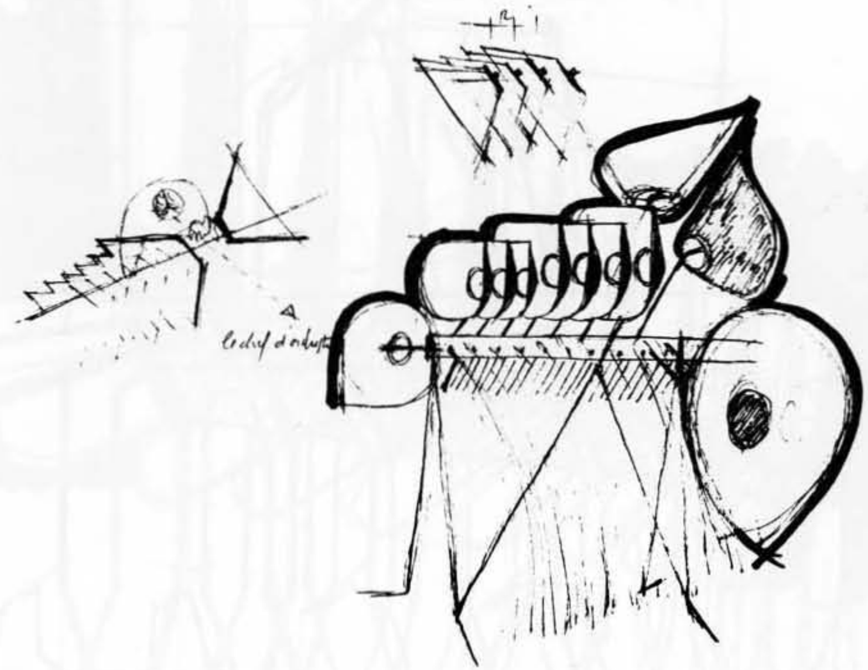
In the States we have finished five structures for the National Theatre for the Deaf. They will be used primarily for background music but experiments are also being carried out at the New York School for the Deaf to make special structures so that the children can feel the vibrations by biting the extensions of the instruments.

Public Participation: We feel that in our present-day computer-card civilisation the public must find new ways of expression. In our performances, whenever it is possible, we invite the public to play. Reactions are very diverse. I encountered some people in a Scandinavian museum watching others playing with the instruments. "Are you looking at the structures?" I asked. "No," they said, "we are watching the public. We have never seen so many Scandinavians so happy without being drunk."

A Note

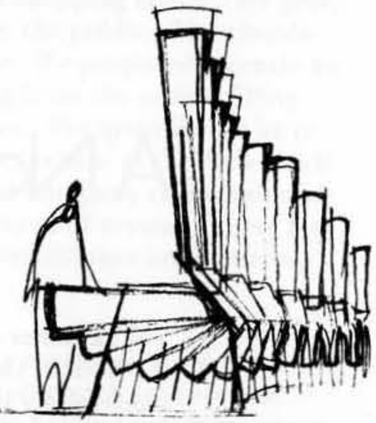
The sketches on the following three pages illustrate some of the conceptual and visual processes involved in the creation of large scale environmental/public Baschet sculptures. The sketches were rendered by the French artist A. Villeminot and are reproduced here with his kind permission.

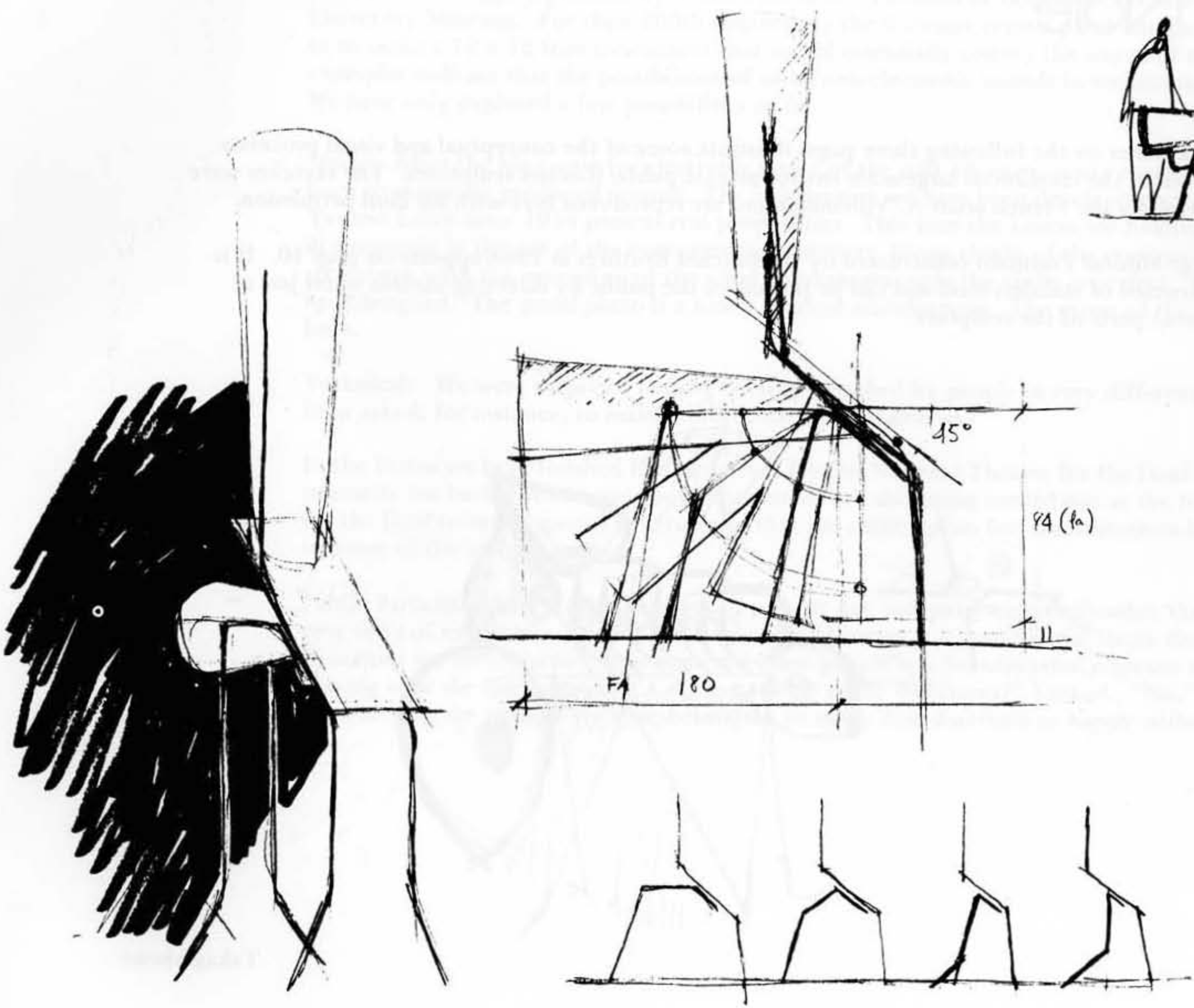
A large Musical Fountain constructed by the Baschet Brothers in 1968 appears on page 10. It is constructed of stainless steel and can be played by the public by directing various water jets at different parts of the sculpture.



Takagiphone

Ikedaphone





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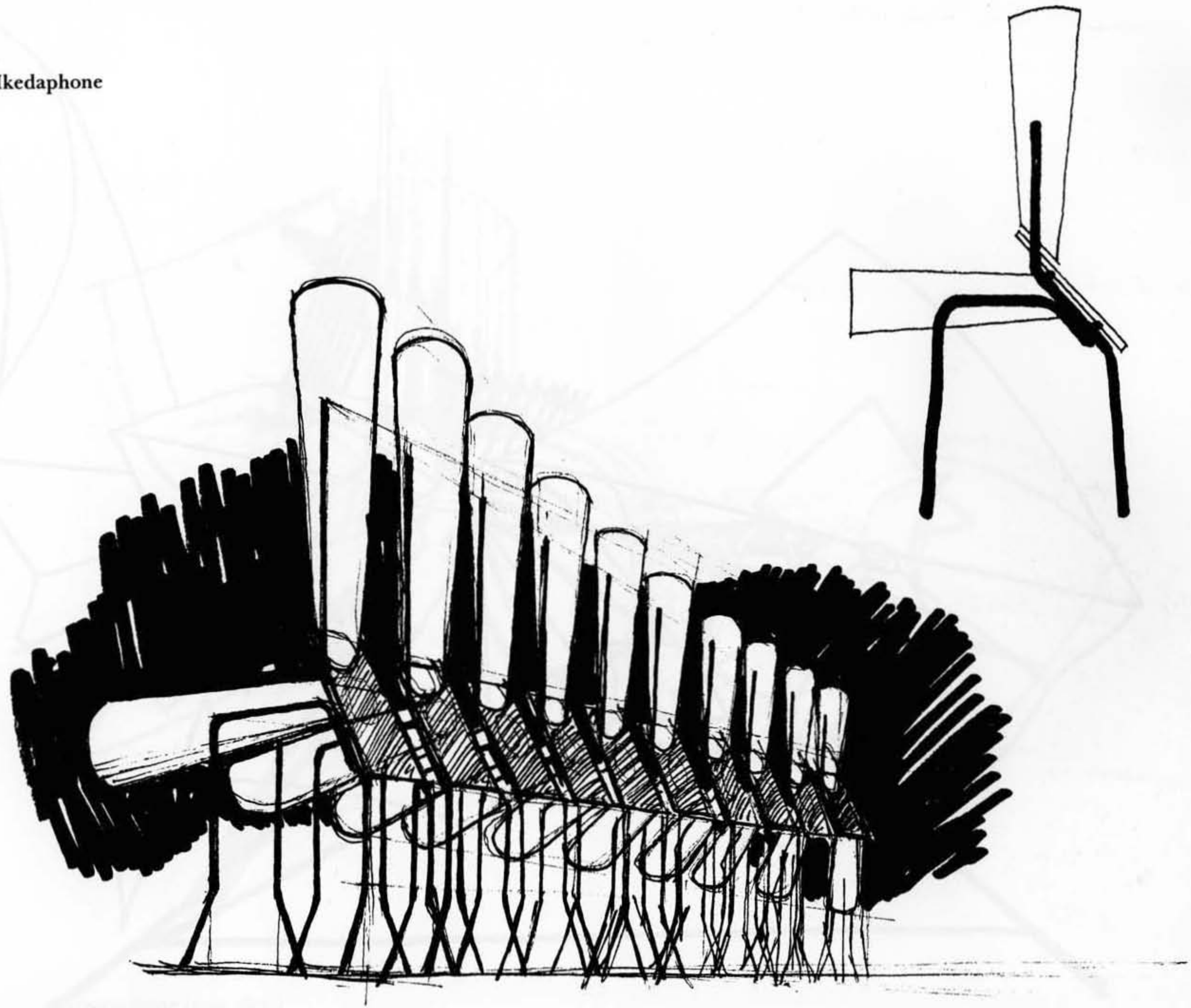
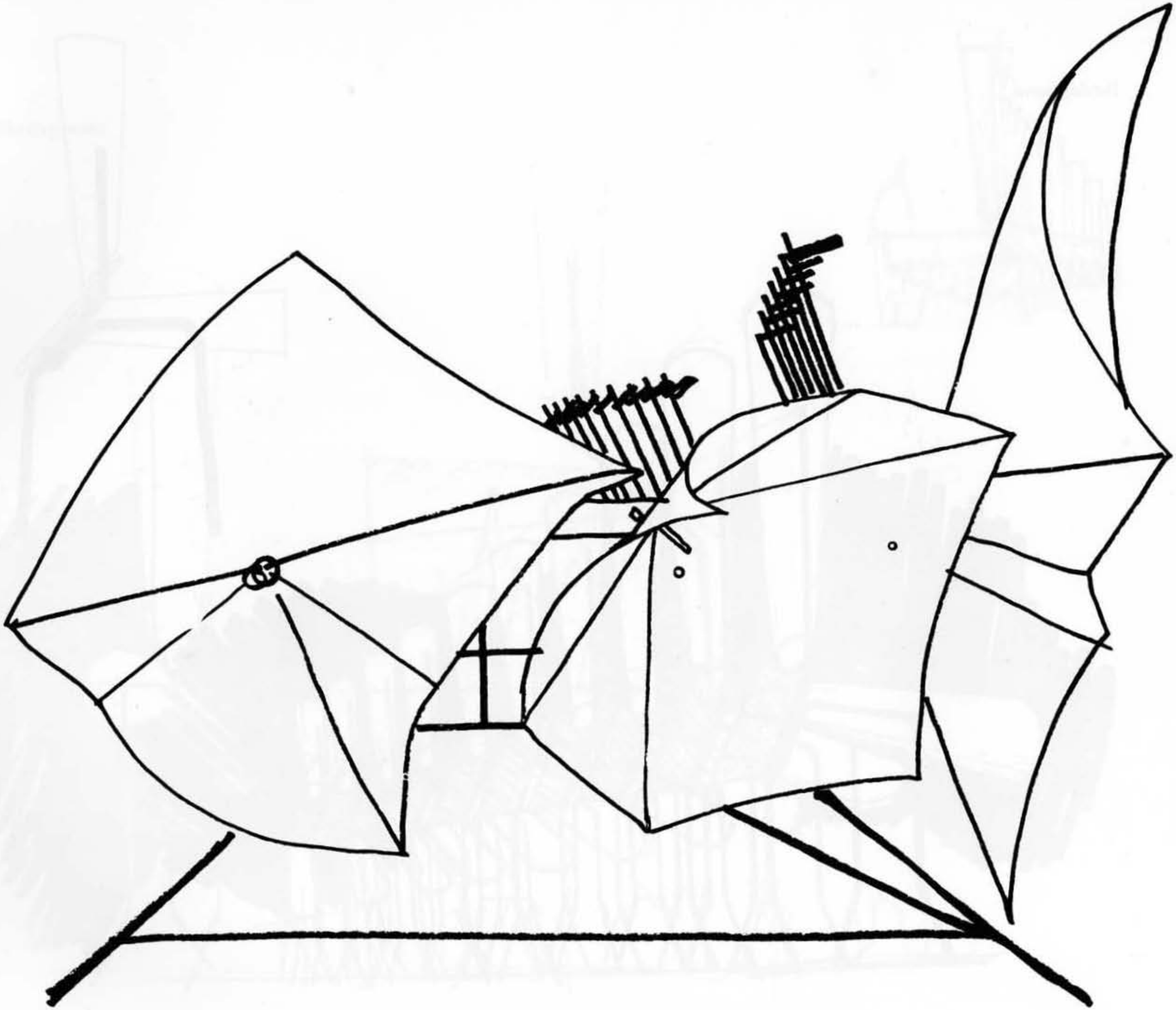
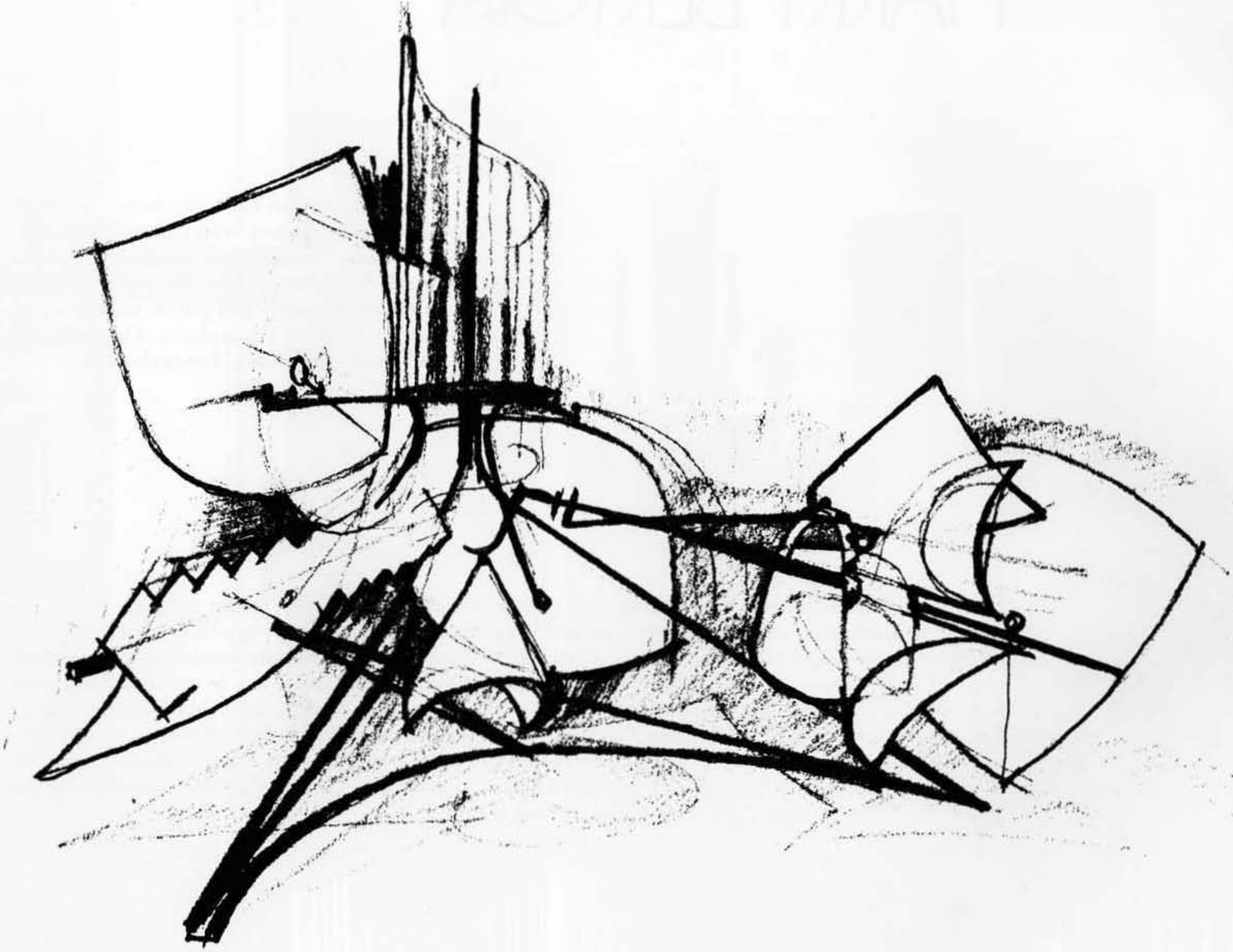




Sekinephone (front view)

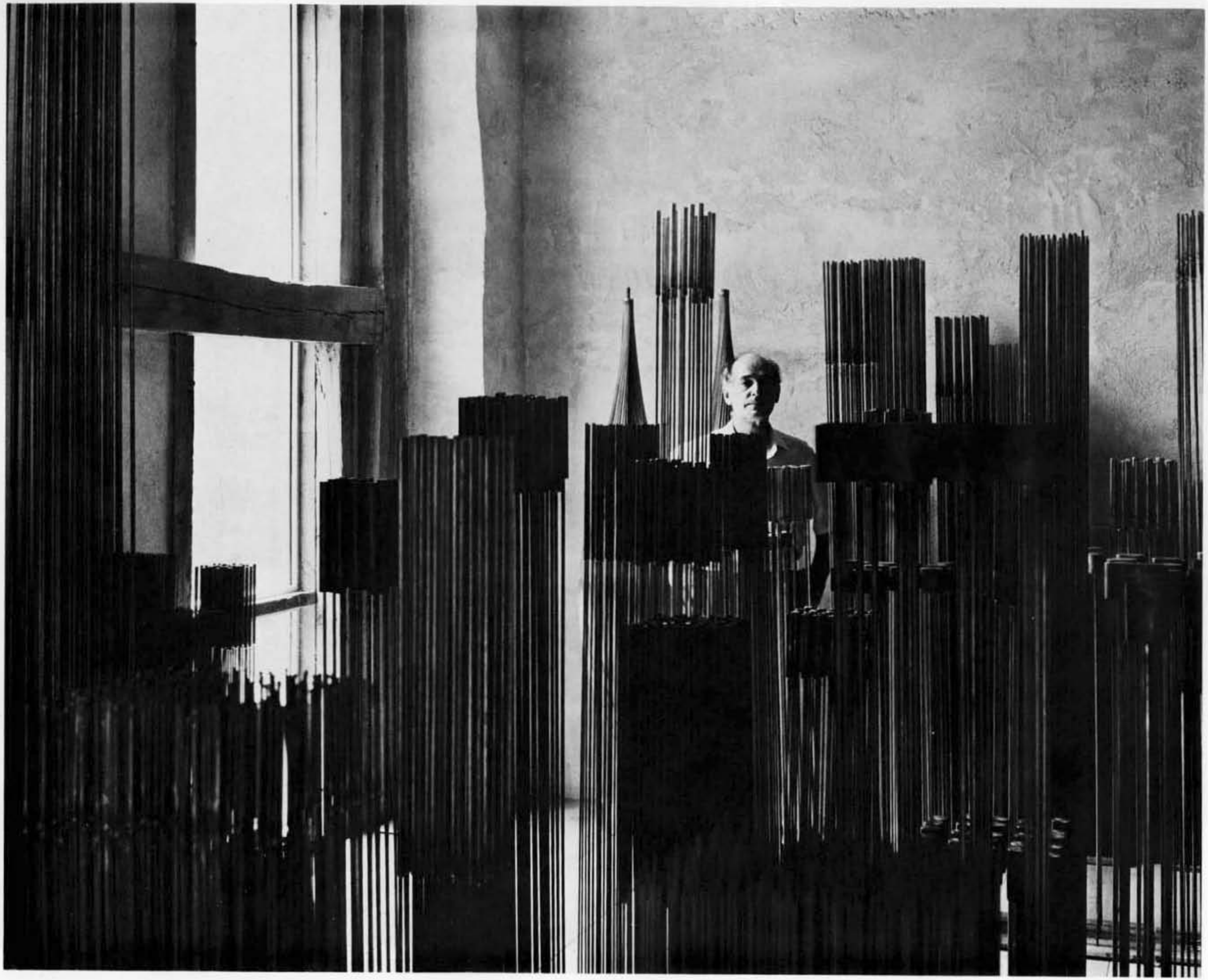


Katsuraphone (rear view)

HARRY BERTOIA

Born 1915 in San Lorenzo, Italy. Moved in 1920 to the United States after a brief stay in Canada. Studied and taught at the Cranbrook Academy of Art. Works to be found in major museums and public areas throughout the Western hemisphere. Currently lives and works near Bally, Pennsylvania.

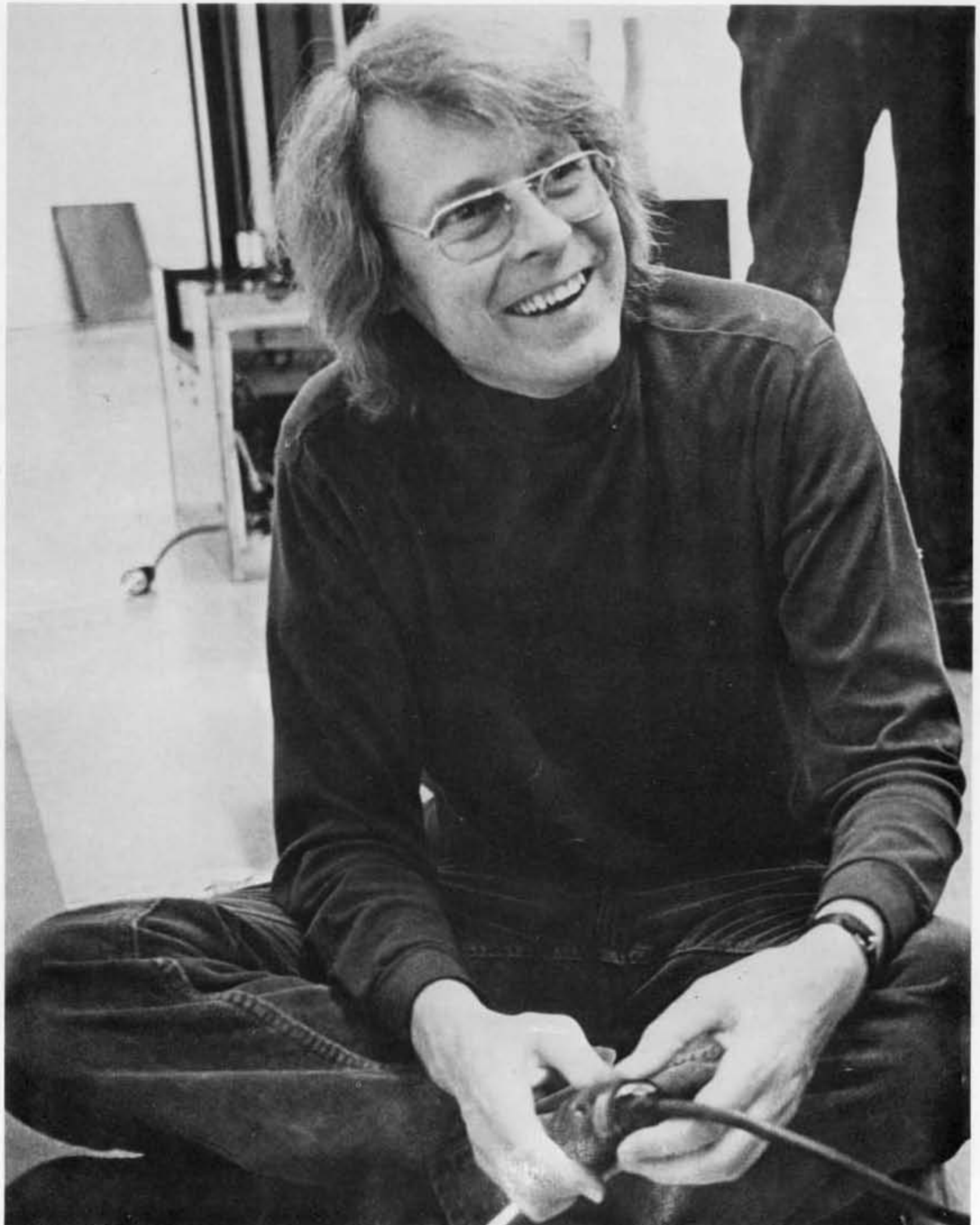
Even though Bertoia has been working with sound in his sculpture for well over a decade, he feels that he has only just begun. Currently he and his brother are continuing experiments with rods of different metals in an effort to produce a full range of tones bearing no relationship to our present musical scale. They have cleared out the barn at his home in Bally and it has been refinished inside to serve as a sounding box (surrounding, rather than within these instuments of music). Bertoia has constructed sculptures of varying metals, thicknesses, and heights, which have been placed inside the barn for further experiments "to develop the range, autonomy, rhythm, and continuity of the sounds." Some of his currently preferred metals are: bronzes (silicone, tobin); beryllium copper; nickel alloys; monels; and the newer alloys of similar quality.



Bertoia in his converted 'sounding box' barn.

Part of Bertoia's private collection of his Sounding Sculptures.

Bertoia's sculptures being played by the public at the Vancouver Art Gallery.



Stephan Von Huene

STEPHAN VON HUENE

Born 1932 in Los Angeles, California. Graduated from Chouinard Art Institute in 1959, and received M.A. from the University of California, Los Angeles in 1965. Currently Associate Dean of the School of Art, California Institute of the Arts.

Animation

by Allan Kaprow

Current art is often made of absences: absence of purpose, absence of meaningful connection between things, absence of material and conceptual definition, absence of elaboration, absence of professionalism, absence of uplifting values, absence of personal identity, absence, even, of pathos. Artists seem intrigued by these gaps, these meta-states that leave things blankly self-evident or connected in perfunctory series like the numbers in a traffic count.

Stephan von Huene's art is one of presences. Not simply the physical presences of well-crafted objects, inventive and focused for eyes and ears; but, rather, 'magical' presences. Here are beings, surrogates for ourselves, who perform for a time and then are mute until requested to act and speak again. Oracles. They communicate in crypto-syllables from a language just beyond translation. They emit hoots, moans, clicks, beeps and breathy sounds, punched out on hidden paper tapes and run by vacuum sweeper motors. I've seen them in their mahogany dusk. Lights shine from their insides. Ceremonies.

For instance: A one-man band without the man who is the band, mechanically having become the band, plays for itself in an empty room. A white rose. Presence of the absence (cf. p. 27).

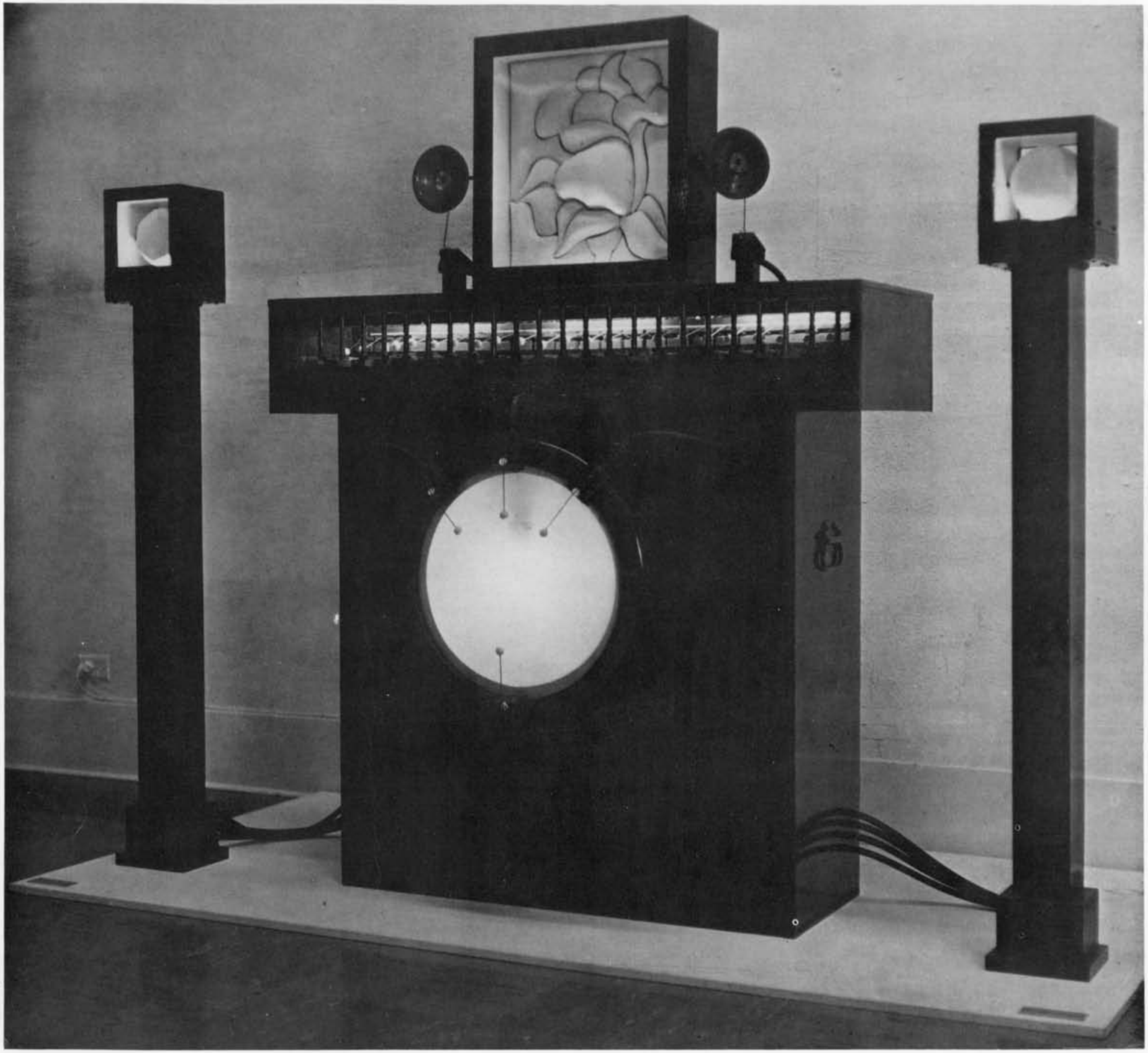
And: A vaudeville team in some bar in 1920 where for a nickel in a slot they'll rag, rattle, tonkle, scrape and blow. Washboard face with cowbell feather. Guardian Nickelodeon. Very serious. Mutt and Jeff at attention (cf. p. 28).

And: Enormous shoes of the clubfoot dandy, tapping away nifty twist of the hard-tipped toes under heavy folded cuffs. Insidious dance to the music we refuse to hear so we listen to the tappety tap of the man we won't see. Tappety (cf. p. 29)

And: Erect wooden columns, alone, in pairs, threes and more (NYC office buildings), floating on contained light, totems intoning cadences of windy stories spoken to the shivering back. Jokes. Jokes you don't laugh at since you don't know when. (Meditative punch-lines.) Squared lips mouthing them, saying something known but forgotten. Dead-pan. Elegant. Ancestor (cf. p. 30).

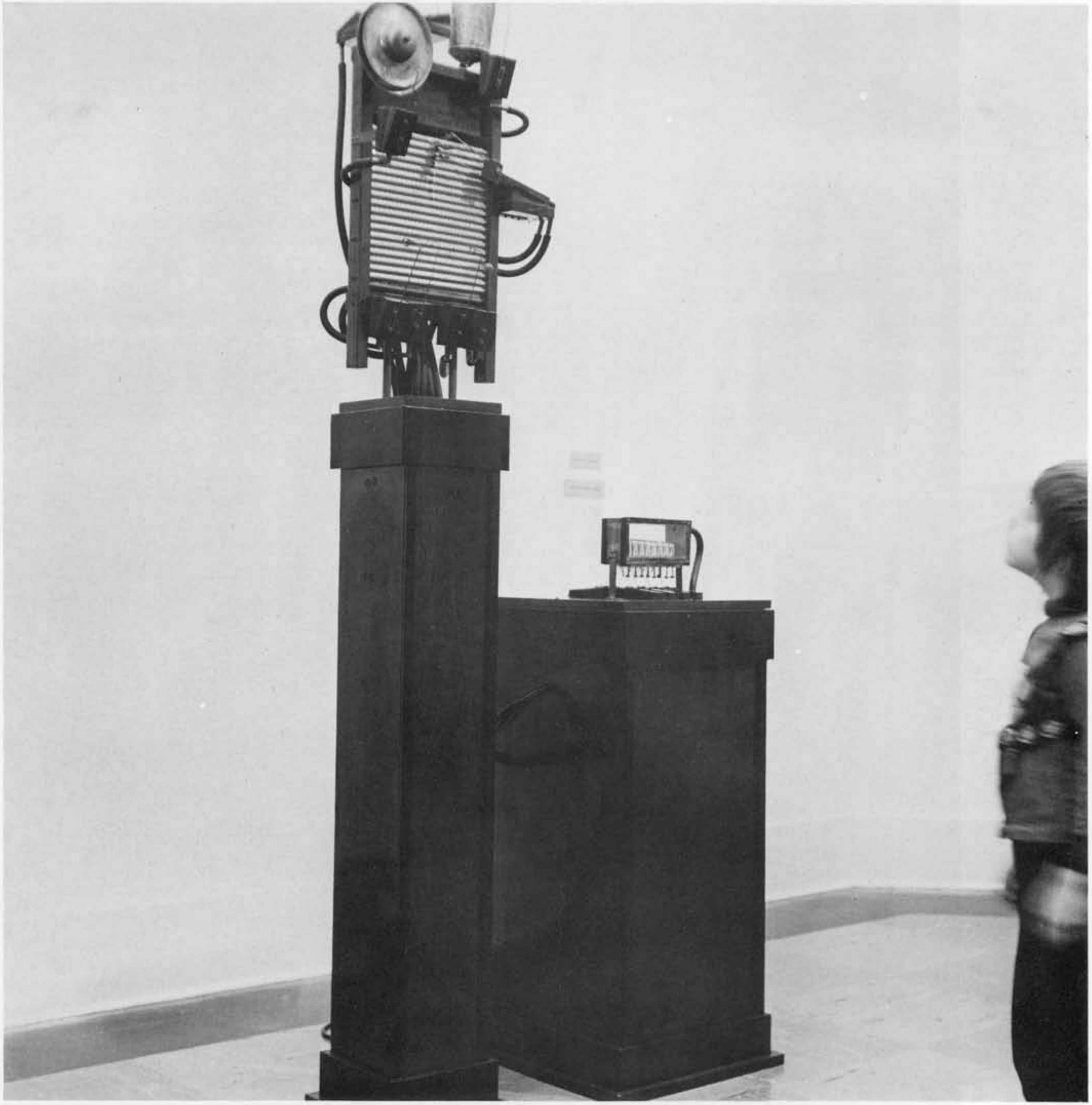
Von Huene's art is located at a point just between those turn-of-the-century fantasies of machines that come alive, and archetypal evocations that reach beyond time. It thus escapes both the topicality of modernism and the datedness of the recent past. There is no nostalgia in his beings who articulate their own existence almost didactically and "in tongues." They seem on their own, stylistically removed from now just enough to perform without either necessity or apology. They are perhaps even a little smug in their mystery. What they are not, that is, what is absent, is of no importance to them. It is what makes their magic so potent.

Von Huene's Totem Tones at the Vancouver Art Gallery



Rosebud Annunciator
wood, formed leather, pneumatic parts, pneumatic system
7x8x4 feet

Washboard Band
wood, leather trim, reeds, pneumatic system
7.5x4.5x2 feet



Tap Dancer
wood, foam covered with leather, pneumatic system
4x4x3 feet

Totem Tone III
wood, leather, pneumatic system
8x4x2 feet

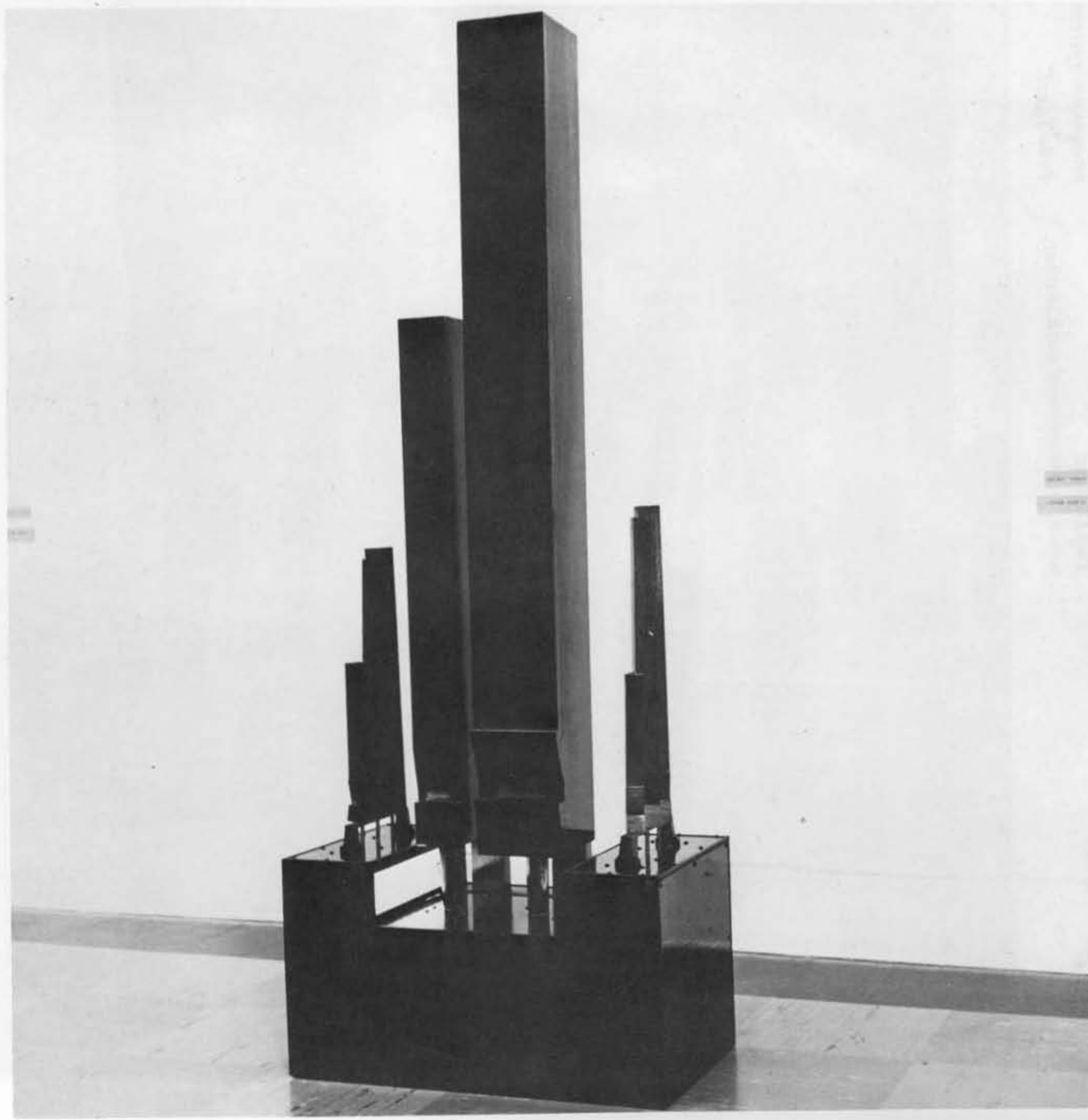
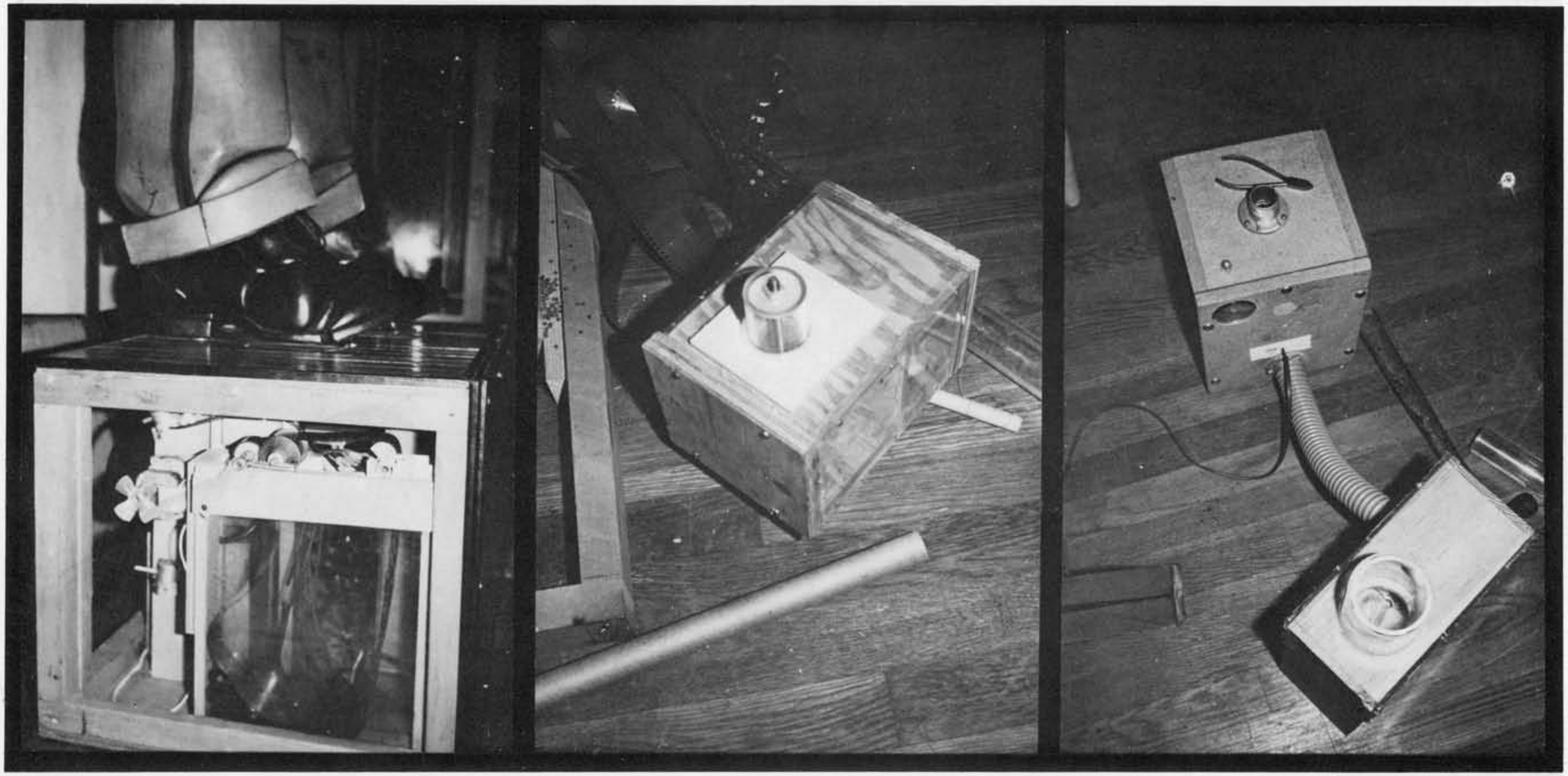
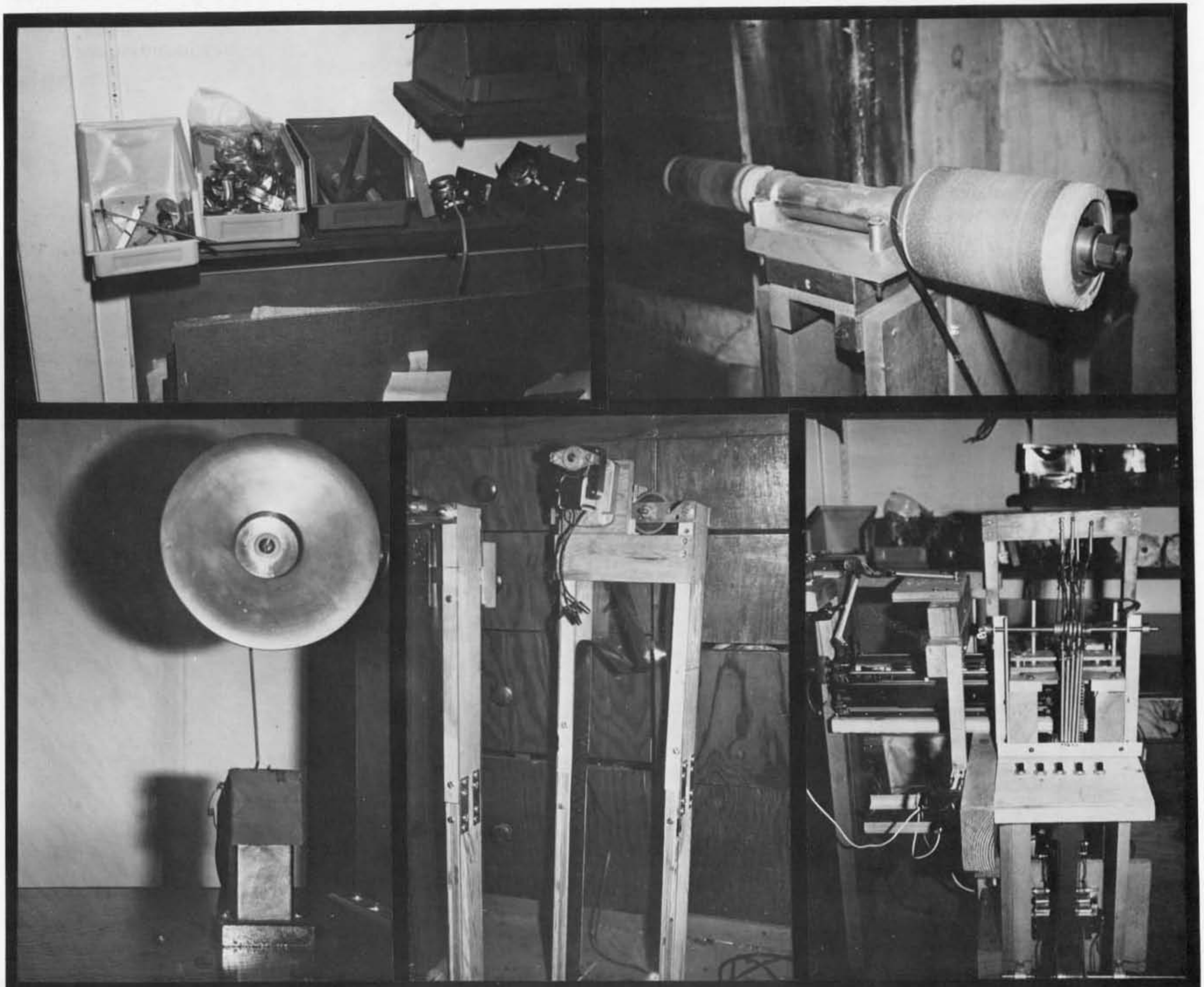
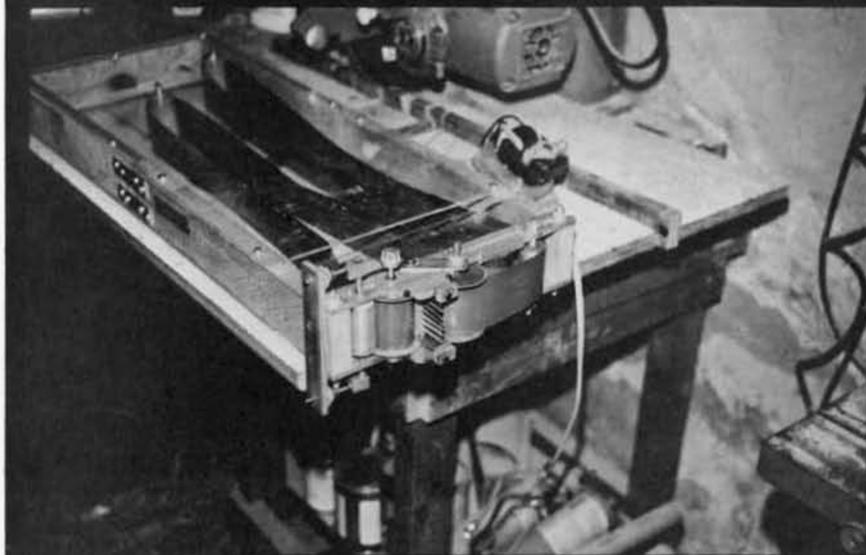


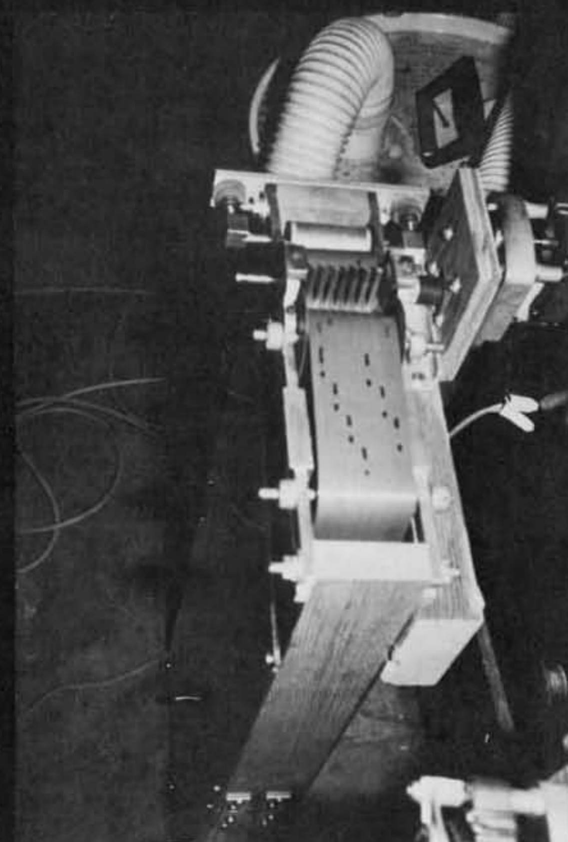
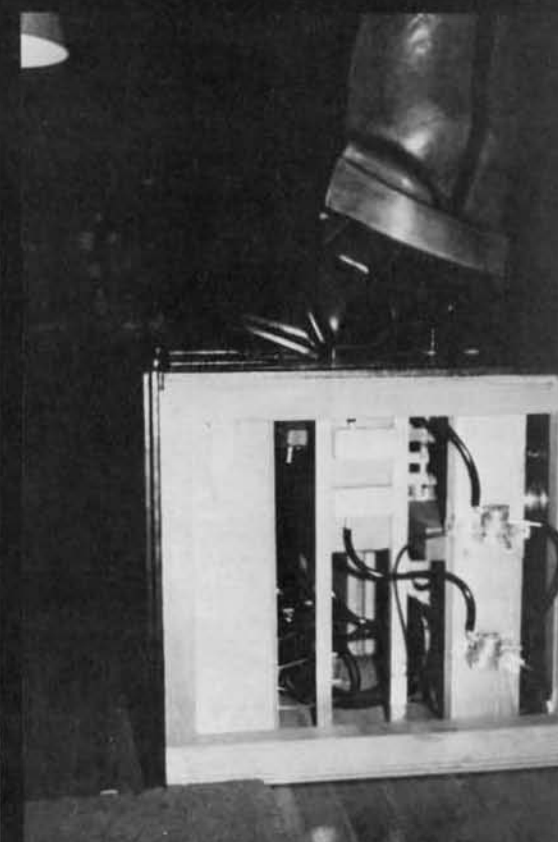
Photo Album

Von Huene compiled a series of informative photos "taken of my machines, inside and outside, of my tools, etc." The photo essay (excerpted) he felt to be the most useful way to depict his way of working in sound sculpture.







David Jacobs

DAVID JACOBS

Born 1932 in Niagara Falls, New York. Studied in California, obtaining his M.A. at Los Angeles State College. Presently Acting Chairman, Fine Arts Department, Hofstra University, New York.

Notebook

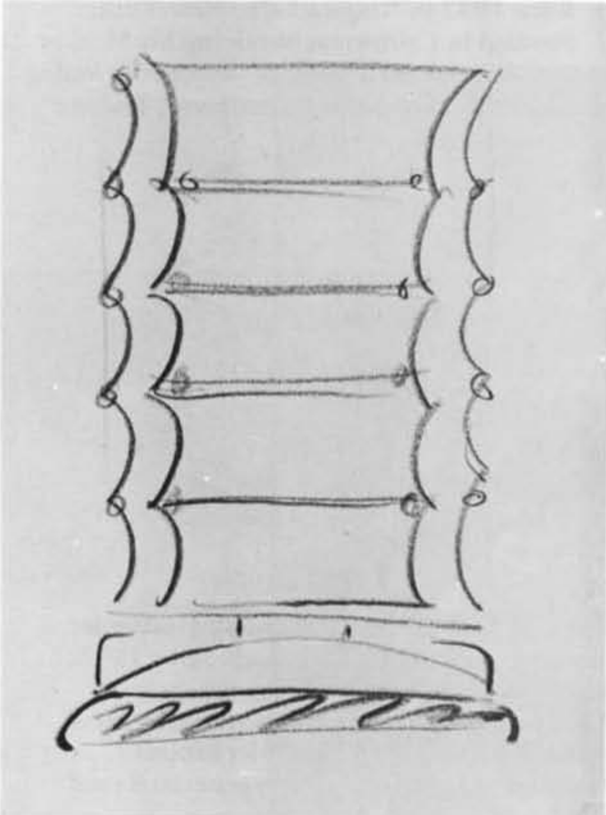
These photographs and pages from my sketchbooks are presented more or less in chronological order and deal with inflating sound sculptures and sound performance/exhibitions I have made since 1967.

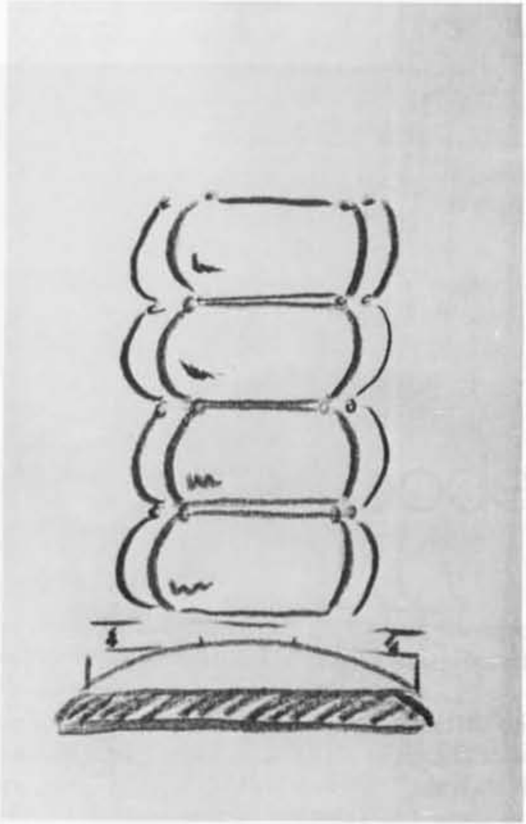
There are two distinct and quite different groups of sound sculptures. The first group was presented variously under the titles "The Wah Chang Box Works Assyrian Air Fair," "Mothers Mechanical Wonderful Wah Wah," "Wonderful Wah Wah," etc., and consisted of sculptures which generated reed sounds and in some cases simple escaping air and motor sounds.

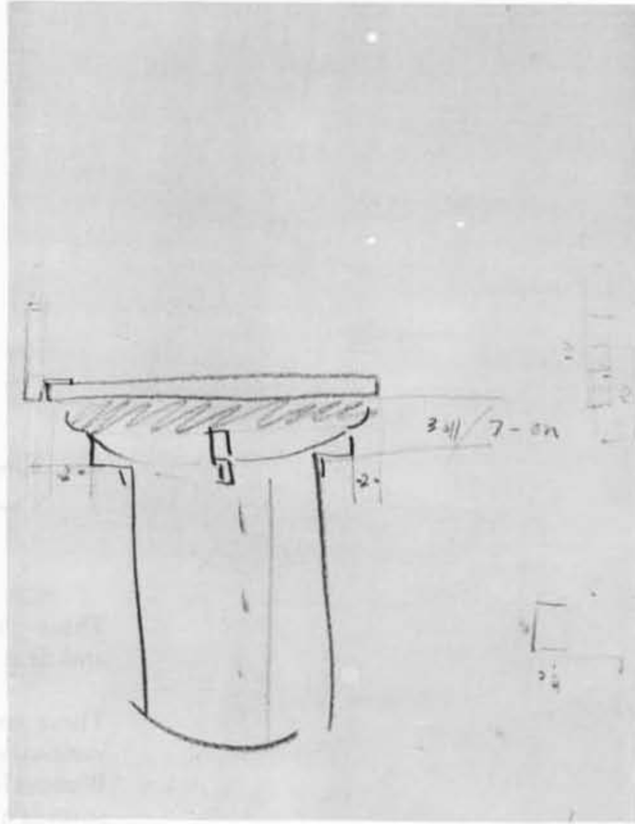
The second group dating from late in 1969 and still being added to is called "Wah Wah" (being the name of each piece as well as the group as well as the performance) and consists of sculptures generating excited columns of air. The more mysterious airy sounds of the Wah Wah seem to defy identification and placement hovering near your ear or in your head or just past you beckoning you to a place of privilege.

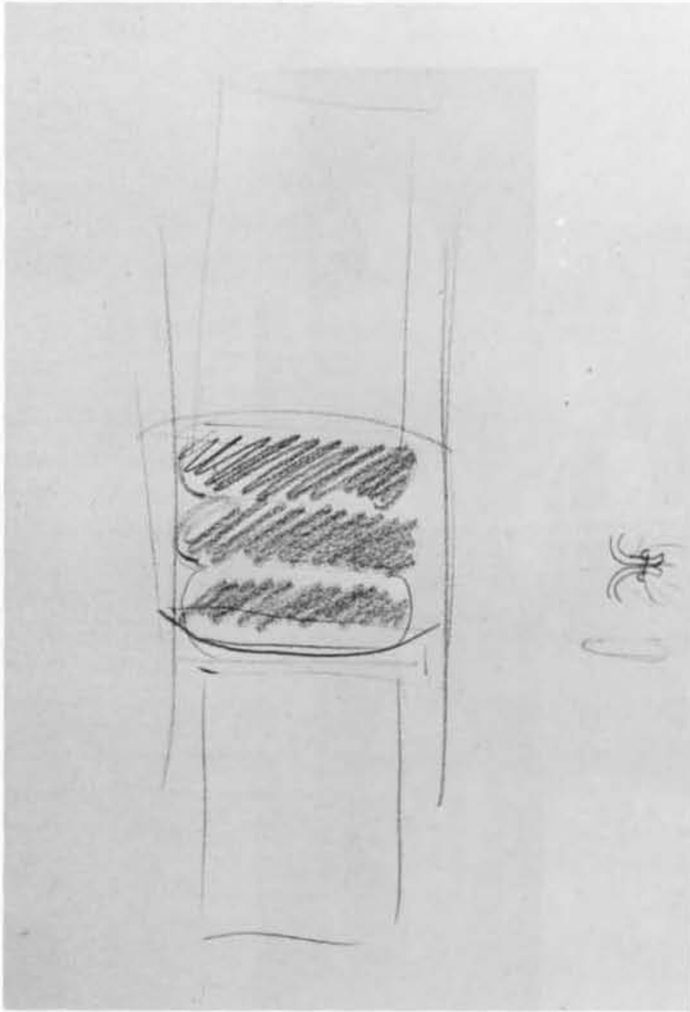
Sound is an integral part of my sculpture at this time, shaping space at least as effectively as any visual elements.

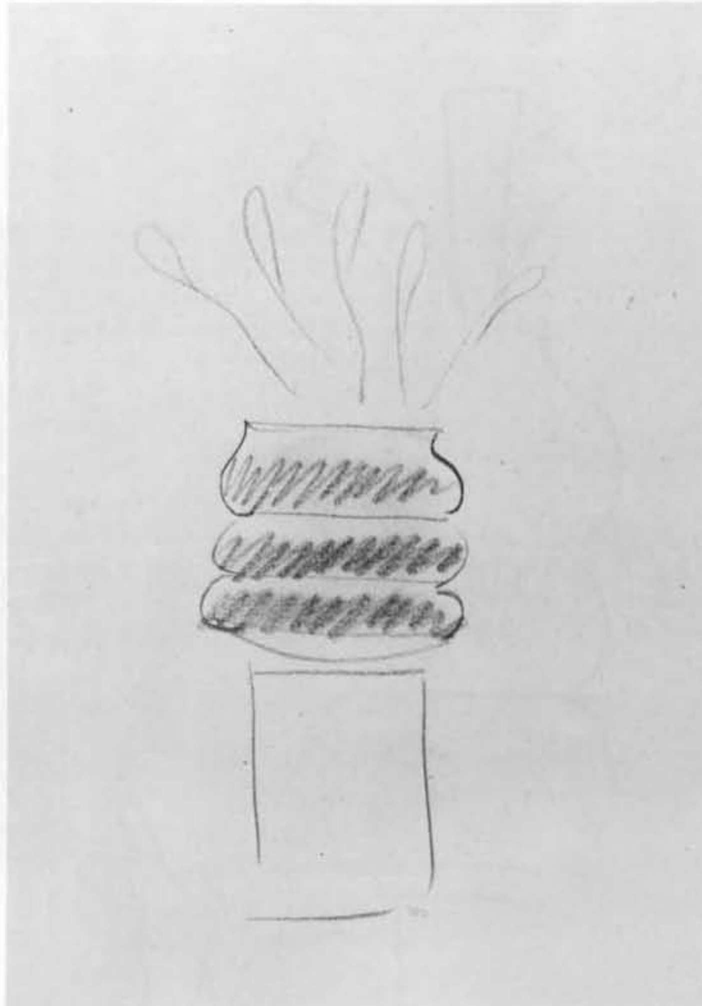
A commentary follows on pages 63-67.

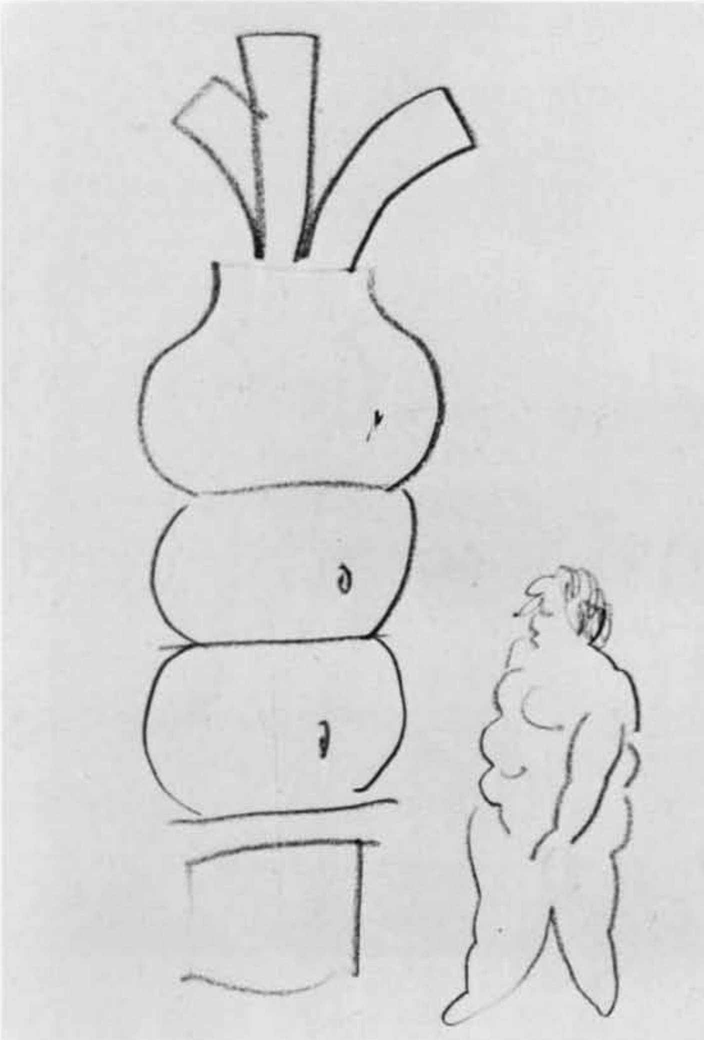


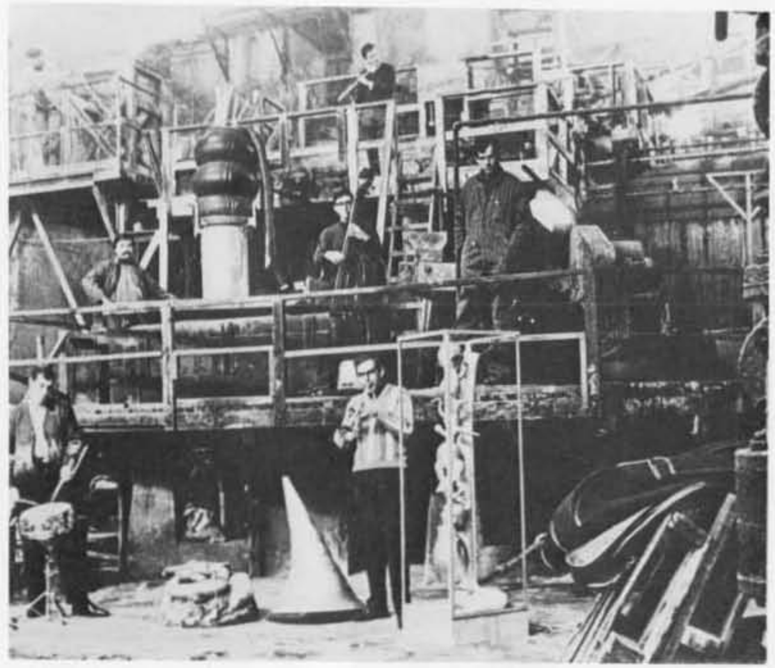


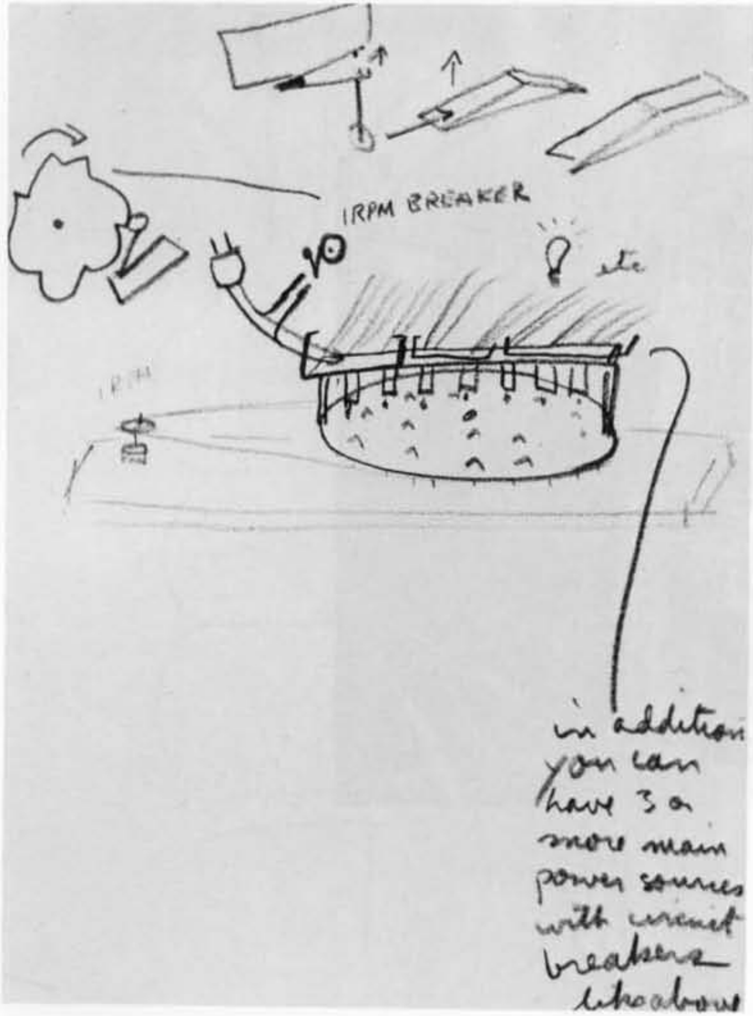


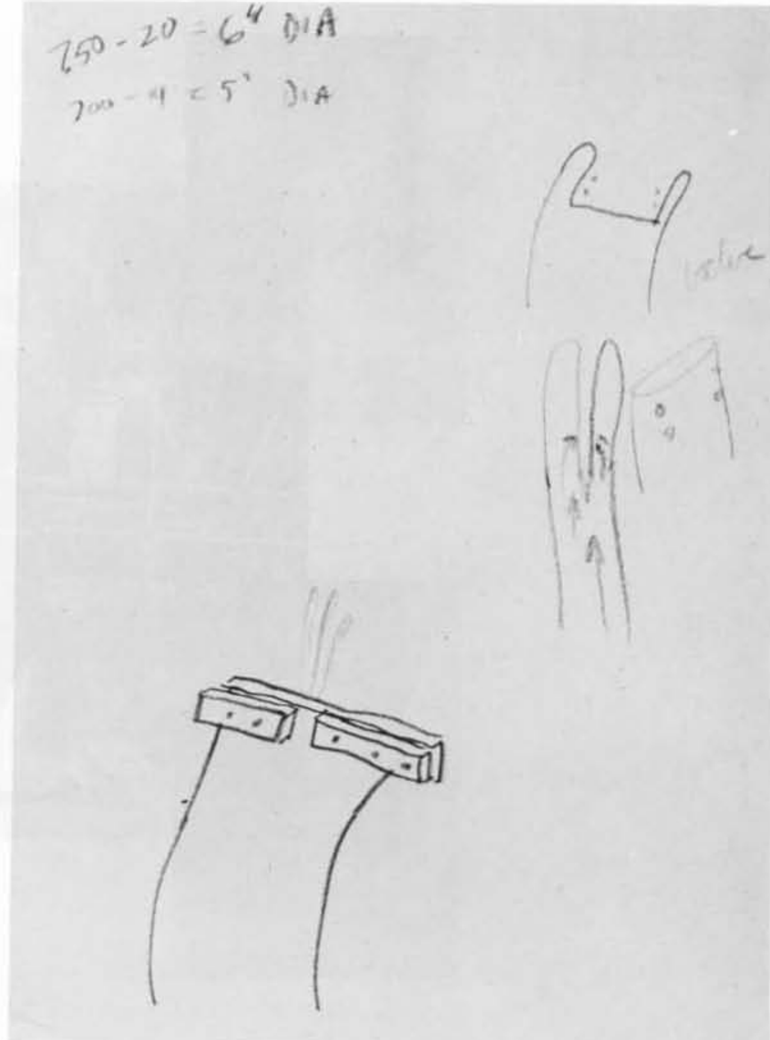


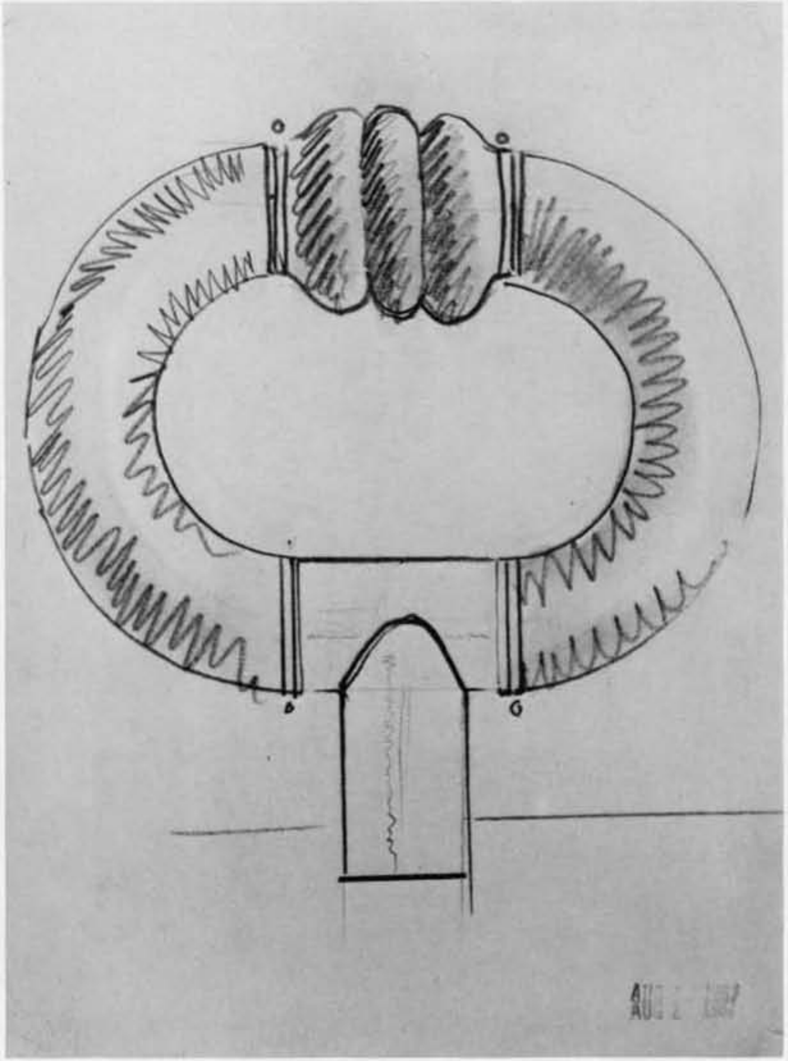


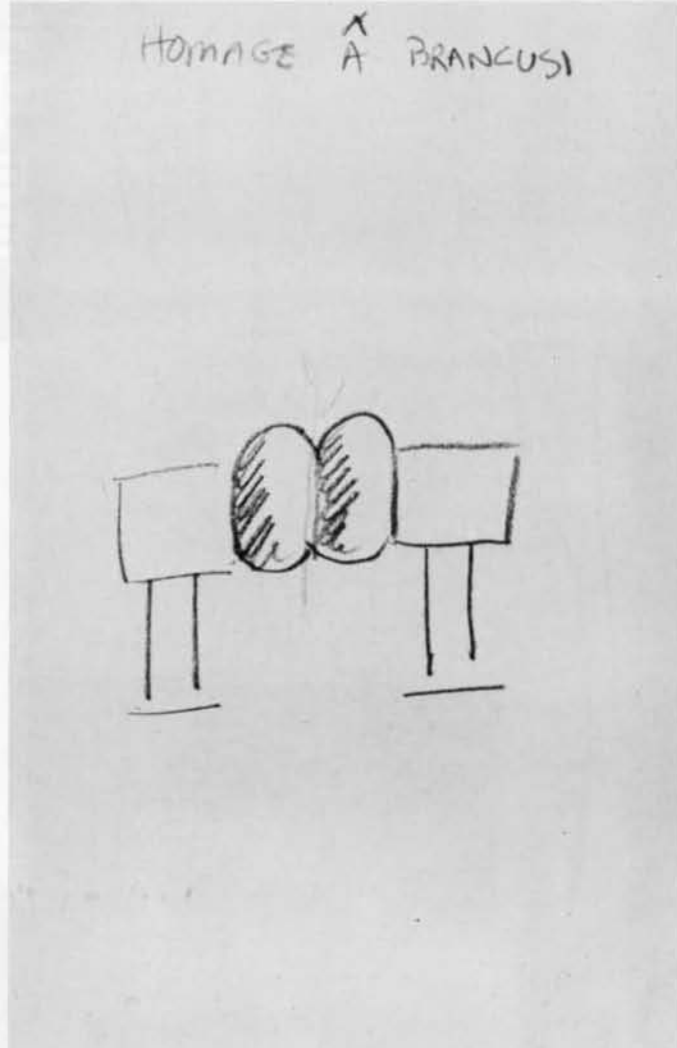


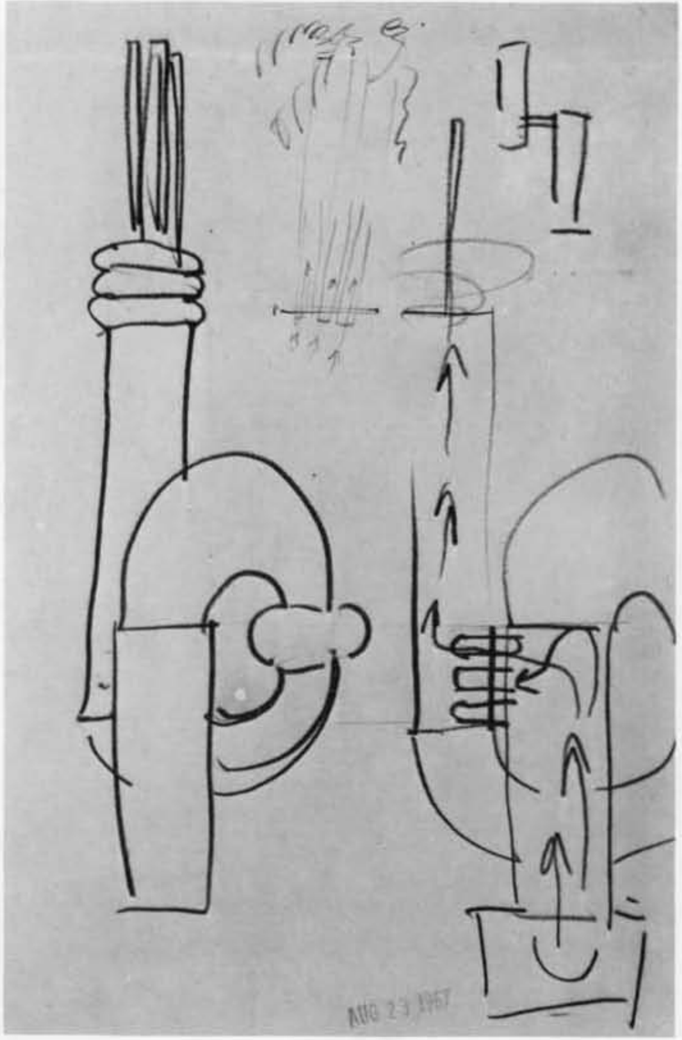


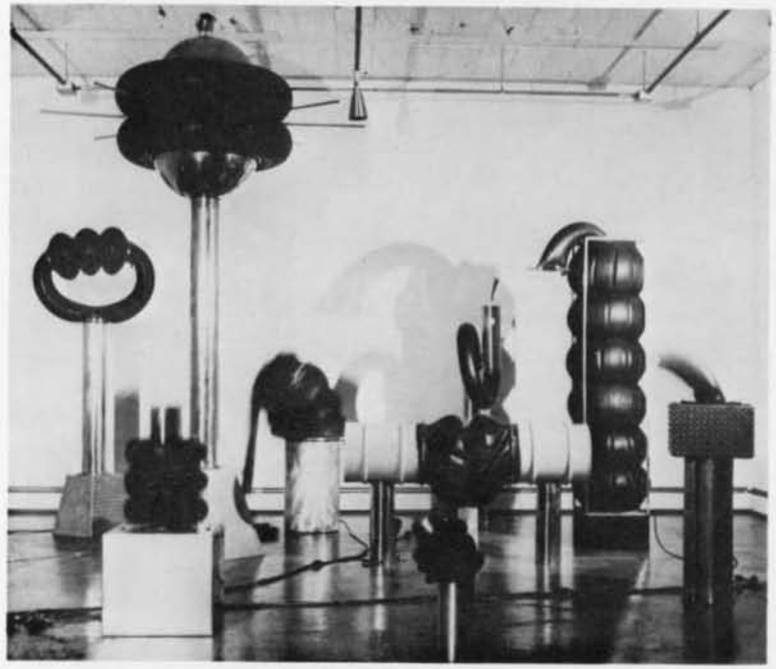

IRPM BREAKER
etc
in addition
you can
have 3 or
more main
power sources
with circuit
breakers
like above


250 - 20 = 6" DIA
700 - 4 = 5' DIA



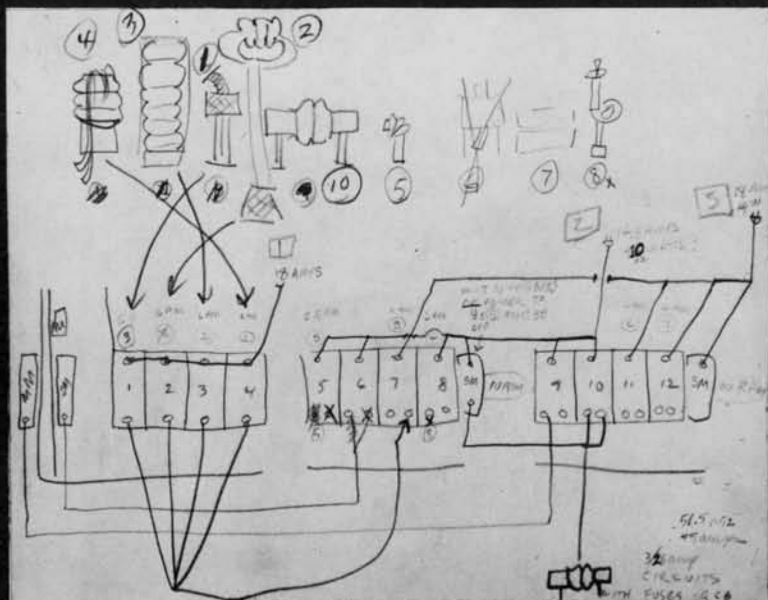

HOMAGE À BRANCUSI


AUG 23 1967



華昌

DAVID JACOBS
WAH CHANG BOX WORKS
63 HERB HILL RD. GLEN COVE
NEW YORK 11542
CODE 516 | OR 6-1313
OR 6-8809



You are invited to the

"WAH CHANG BOX WORKS
ASSYRIAN AIR FAIR, BABY"

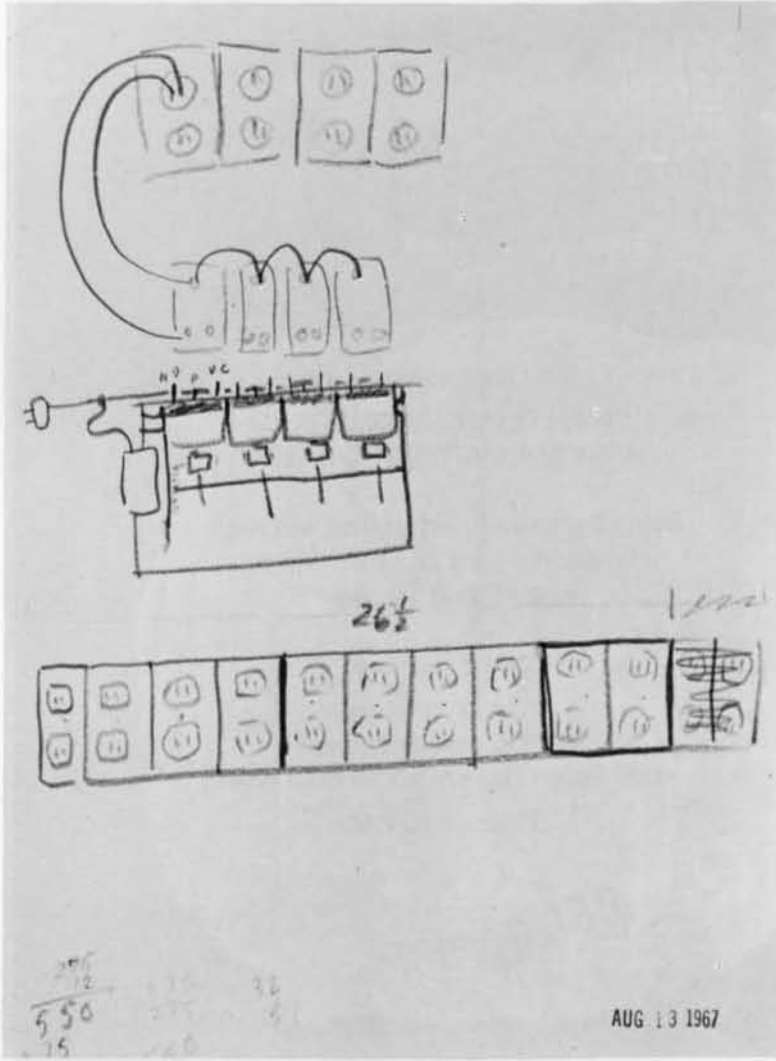
Being a group of performing, singing,
breathing, hard and soft things,
by David Jacobs

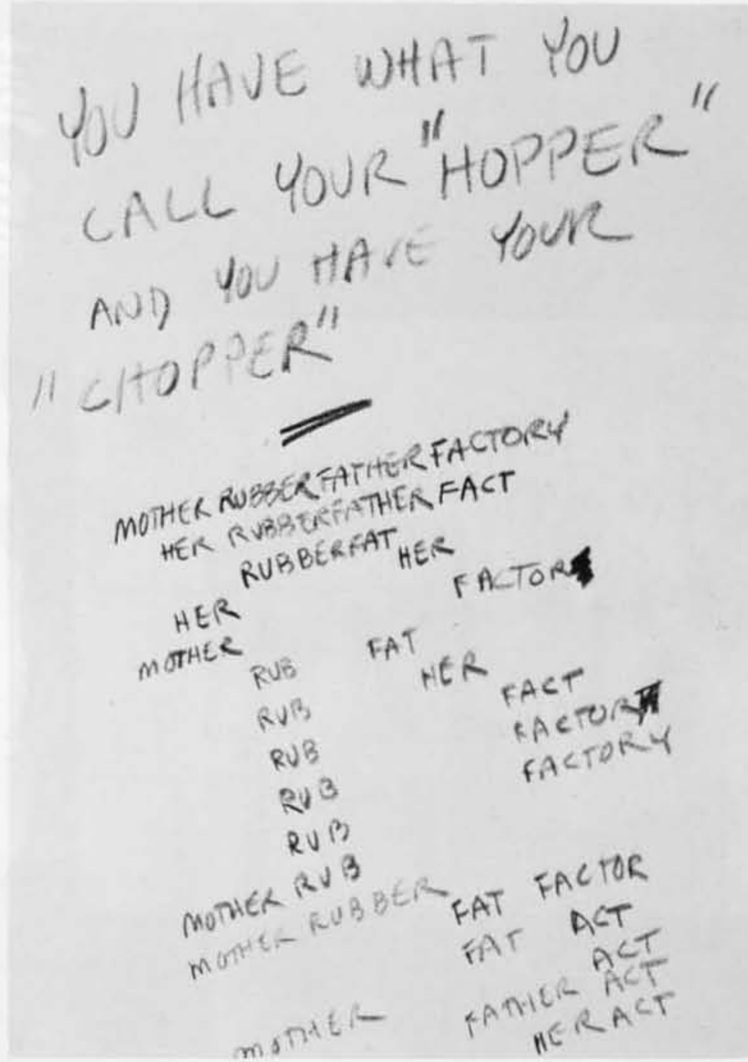
At the studio of

Allan D'Arcangelo
127 Columbus Avenue
at 66 Street (opposite Lincoln Center)

Time: 9:30 P.M.

DEC 3 1967


26½
AUG 13 1967


YOU HAVE WHAT YOU
CALL YOUR "HOPPER"
AND YOU HAVE YOUR
"CHOPPER"
MOTHER RUBBER FATHER FACTORY
HER RUBBER FATHER FACT
RUBBER FAT HER
FACTOR
HER
MOTHER
RUB
FAT
HER
FACT
RUB
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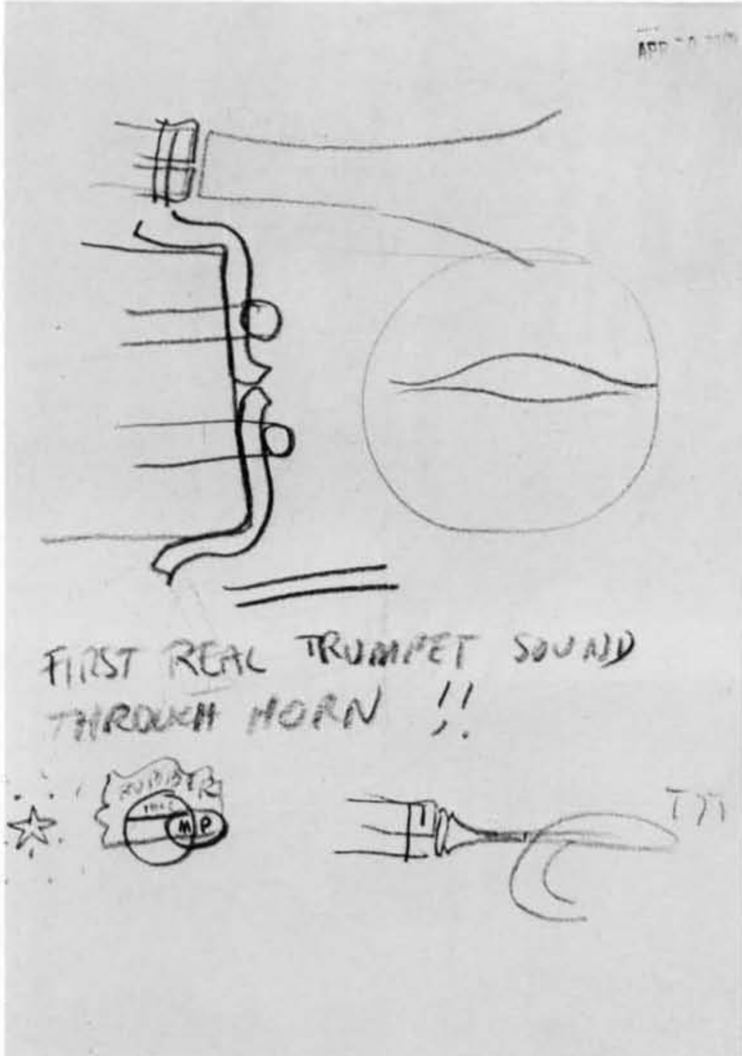
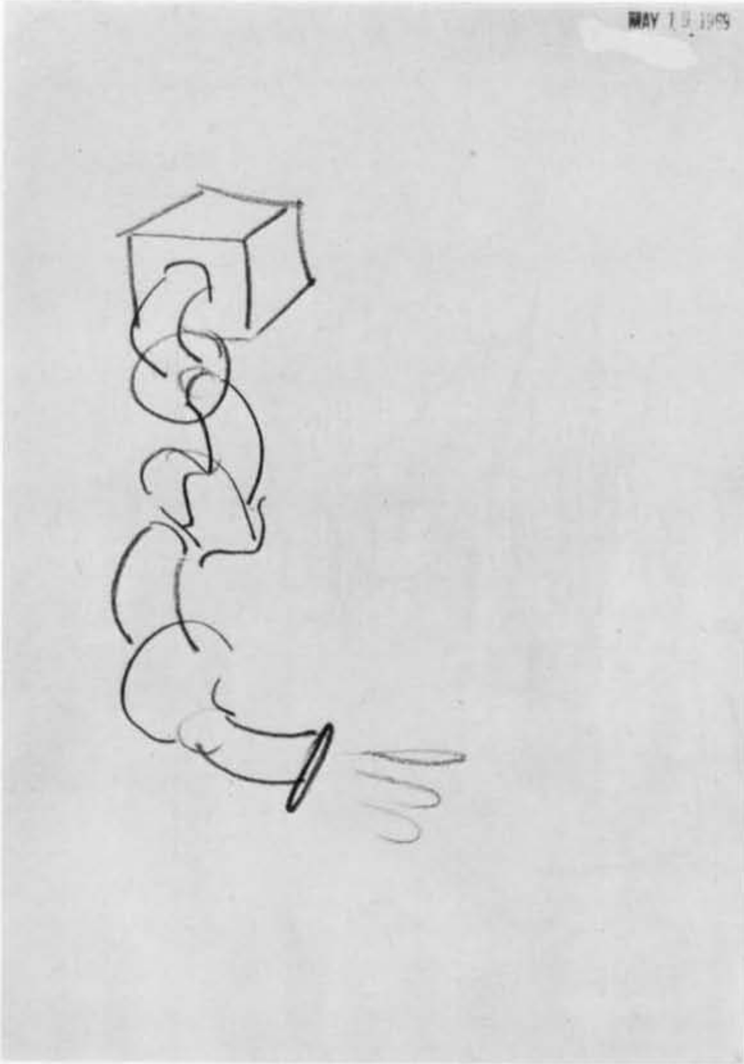
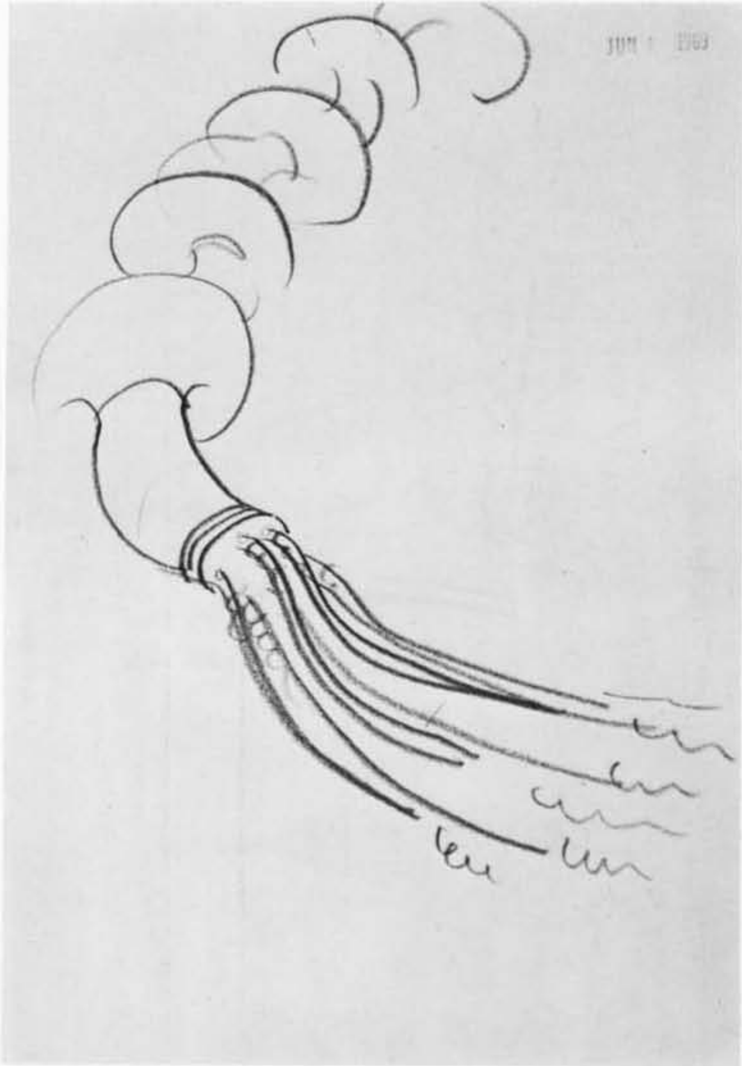
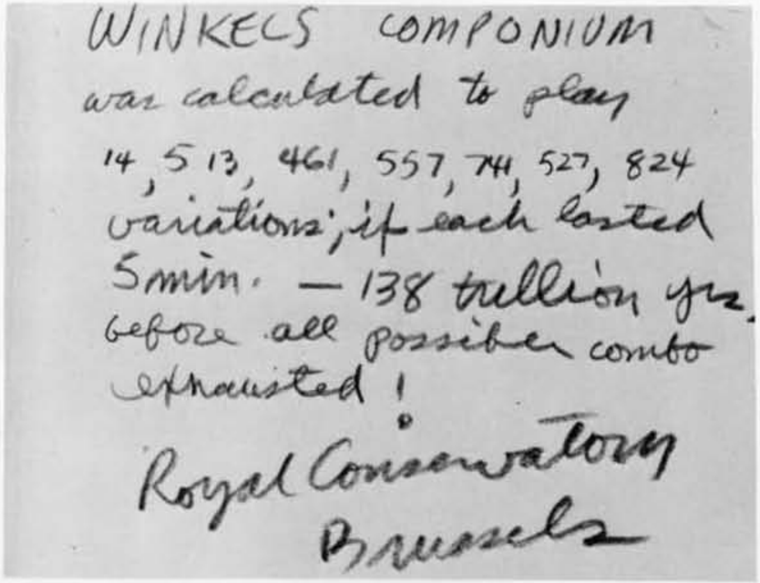
MOTHER RUB
MOTHER RUBBER
FAT FACTOR
FAT ACT
FATHER ACT
HER ACT
MOTHER


FIRST REAL TRUMPET SOUND
THROUGH HORN !!

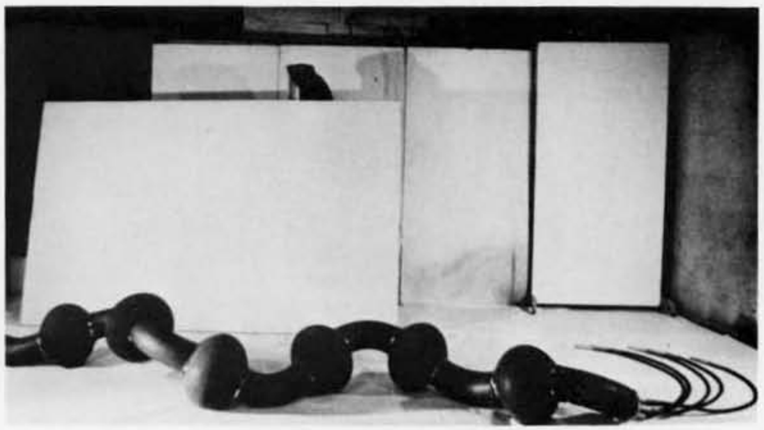

F. KAUFMANNS TRUMPETER
1810
German Museum Munich
written about by Carl Maria von Weber
also made "BELLONEON"

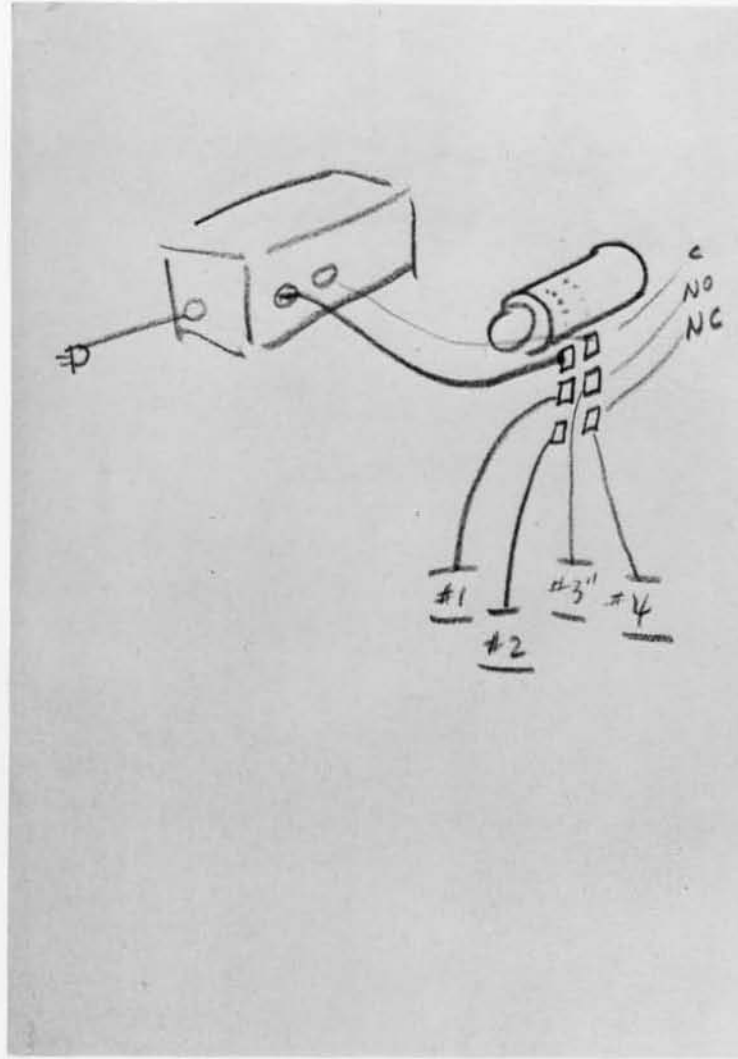


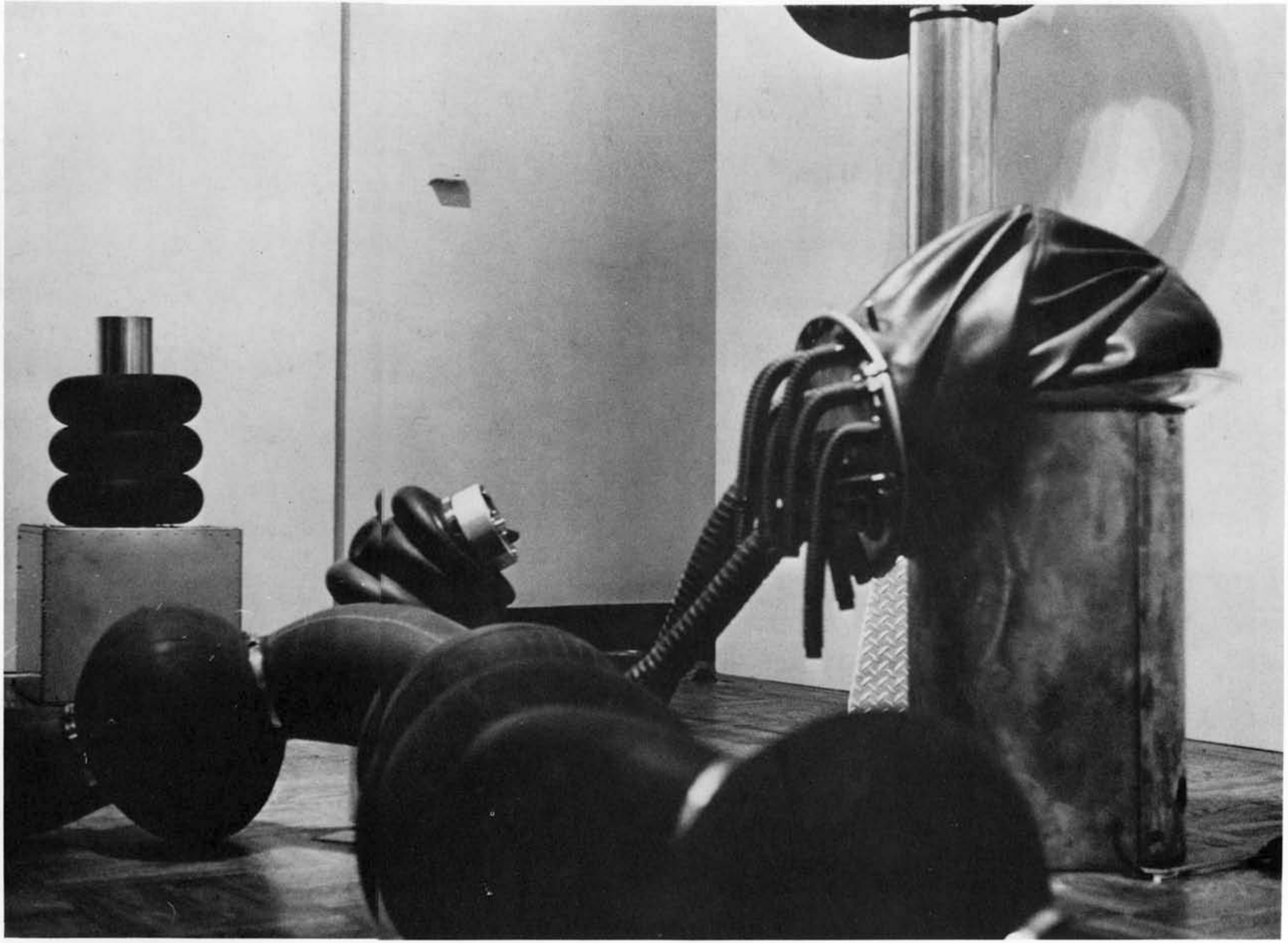


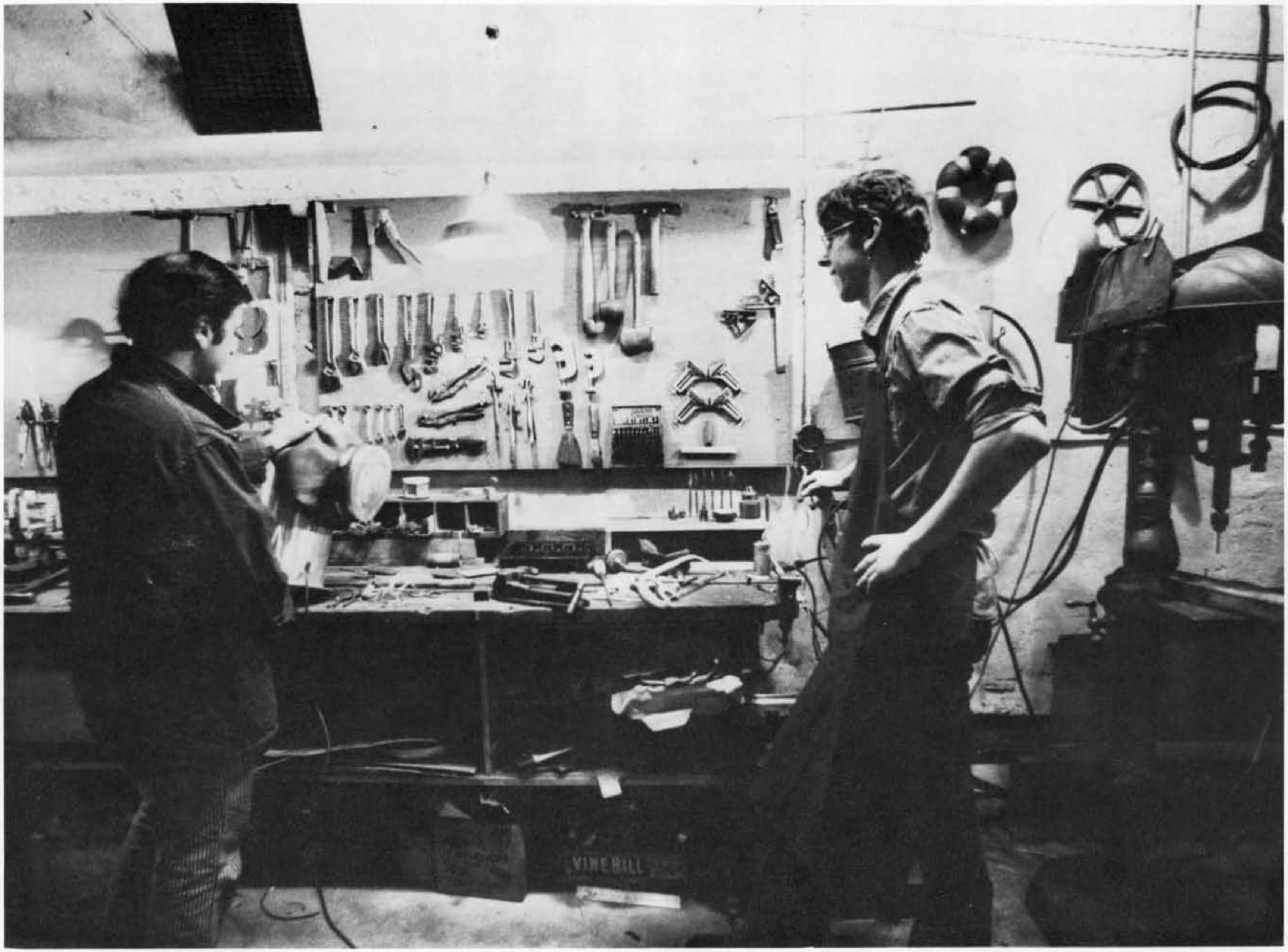


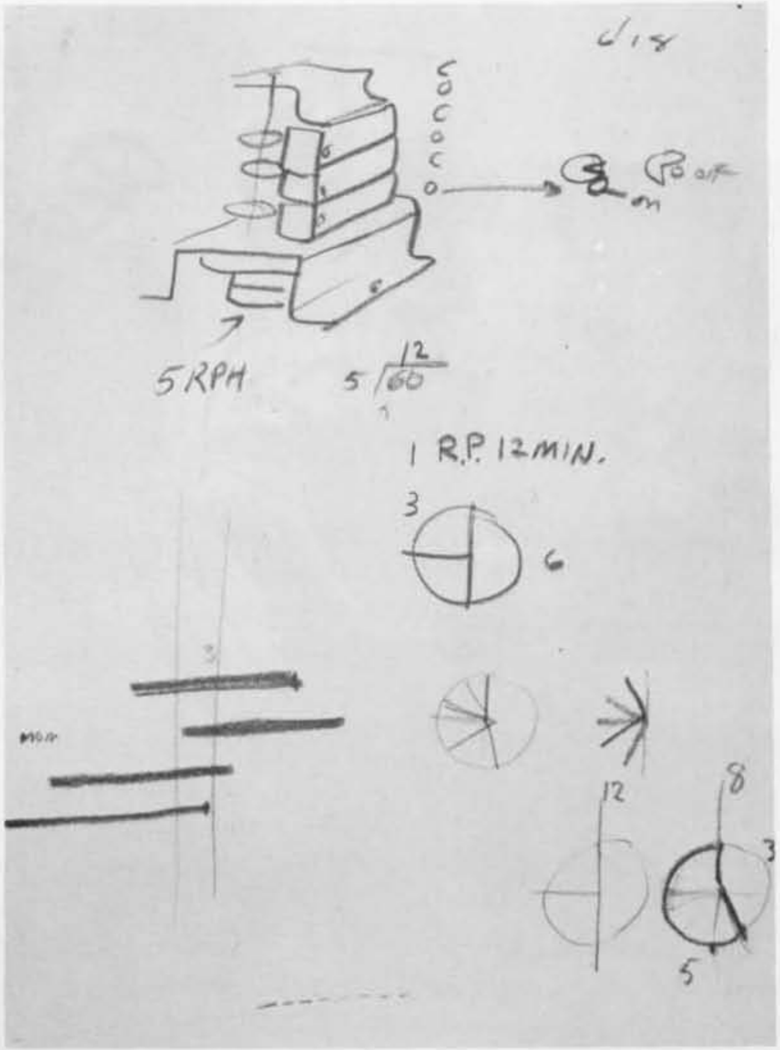
WINKELS COMPONIUM
was calculated to play
14,513,461,557,741,527,824
variations; if each lasted
5 min. — 138 trillion yrs.
before all possible combo
exhausted!
Royal Conservatory
Brussels

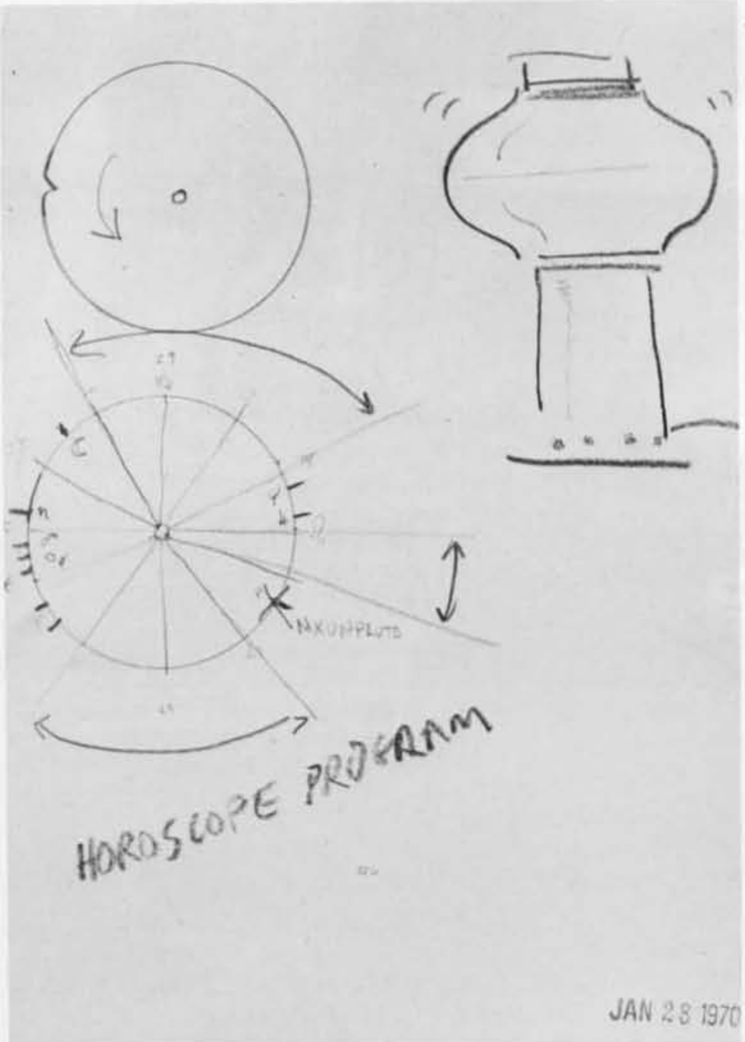


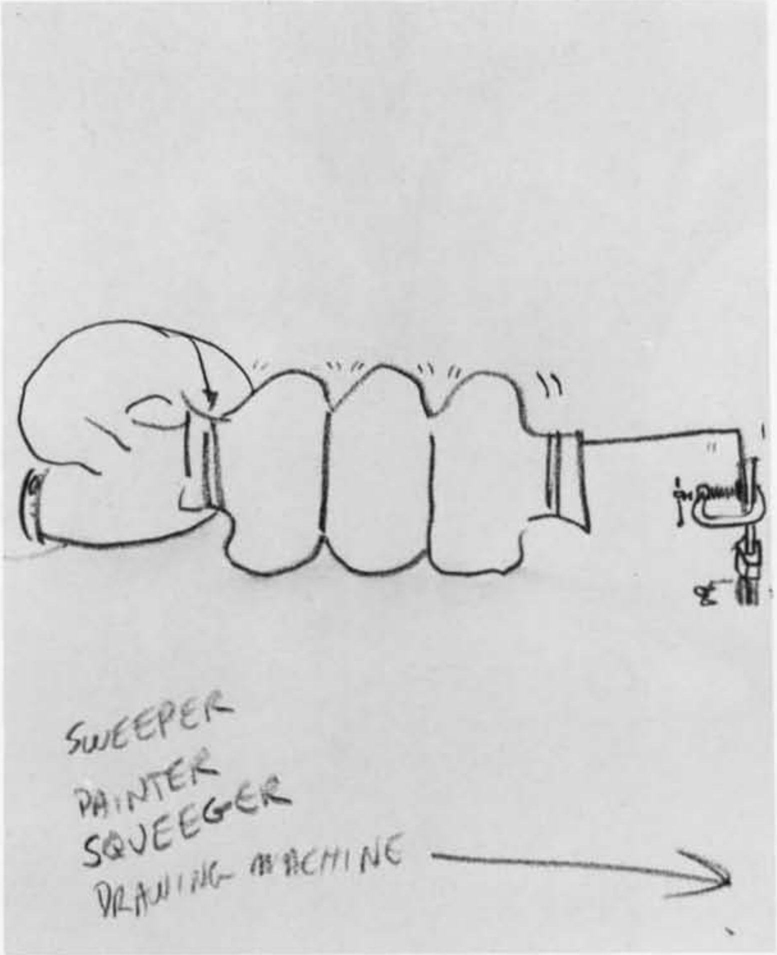


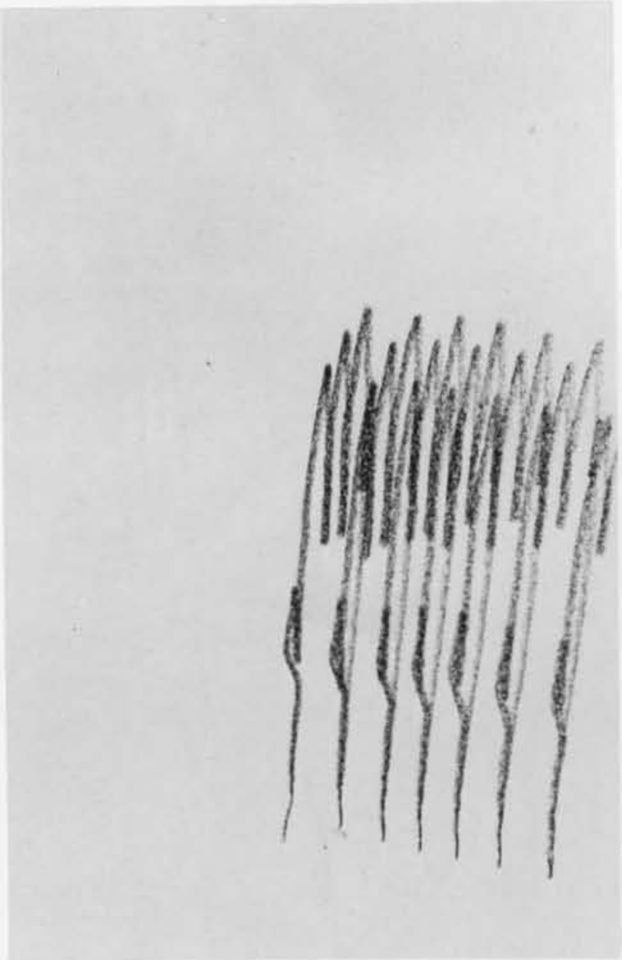


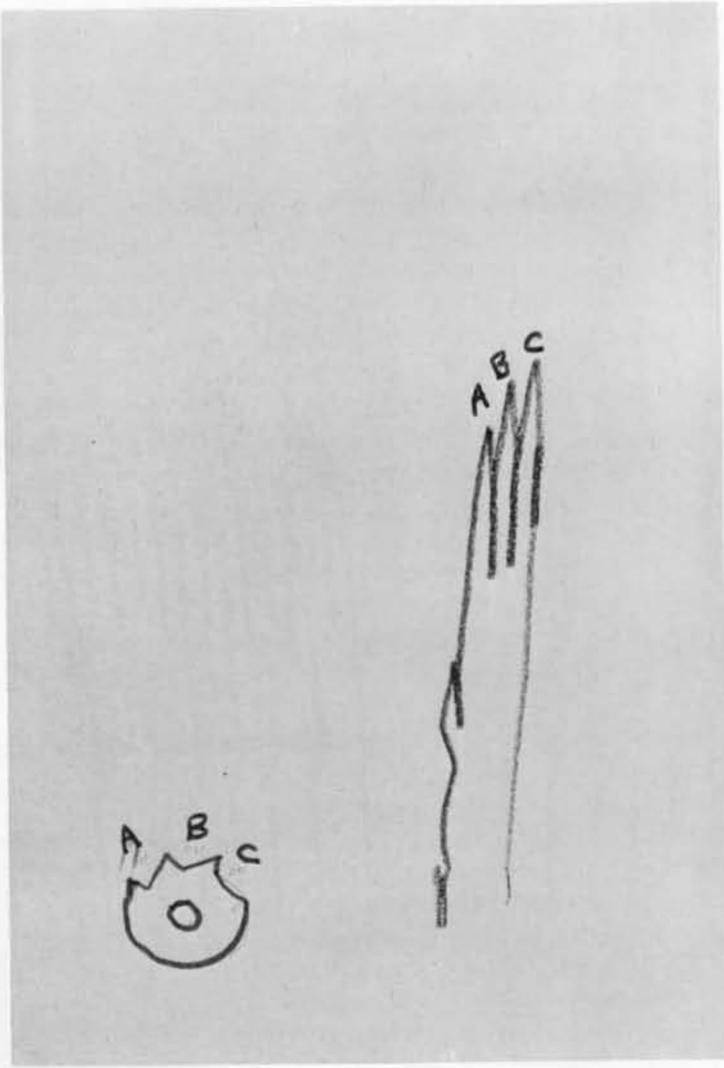

VINE HILL

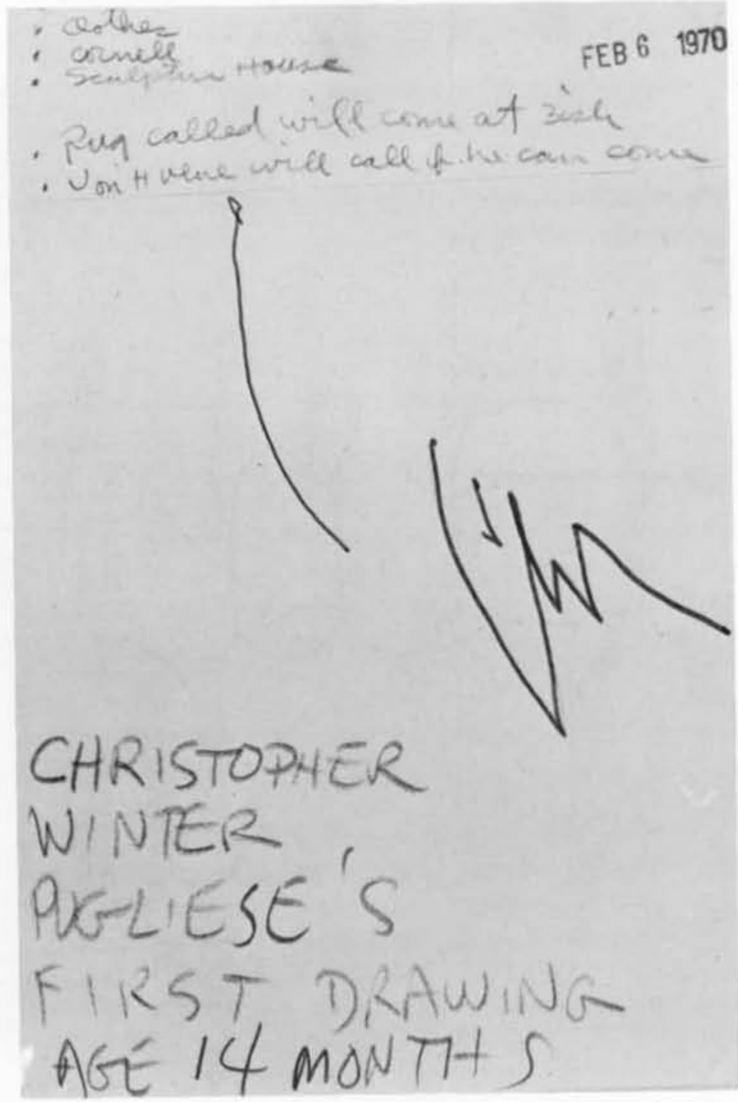

5 RPH
1 R.P. 12 MIN.

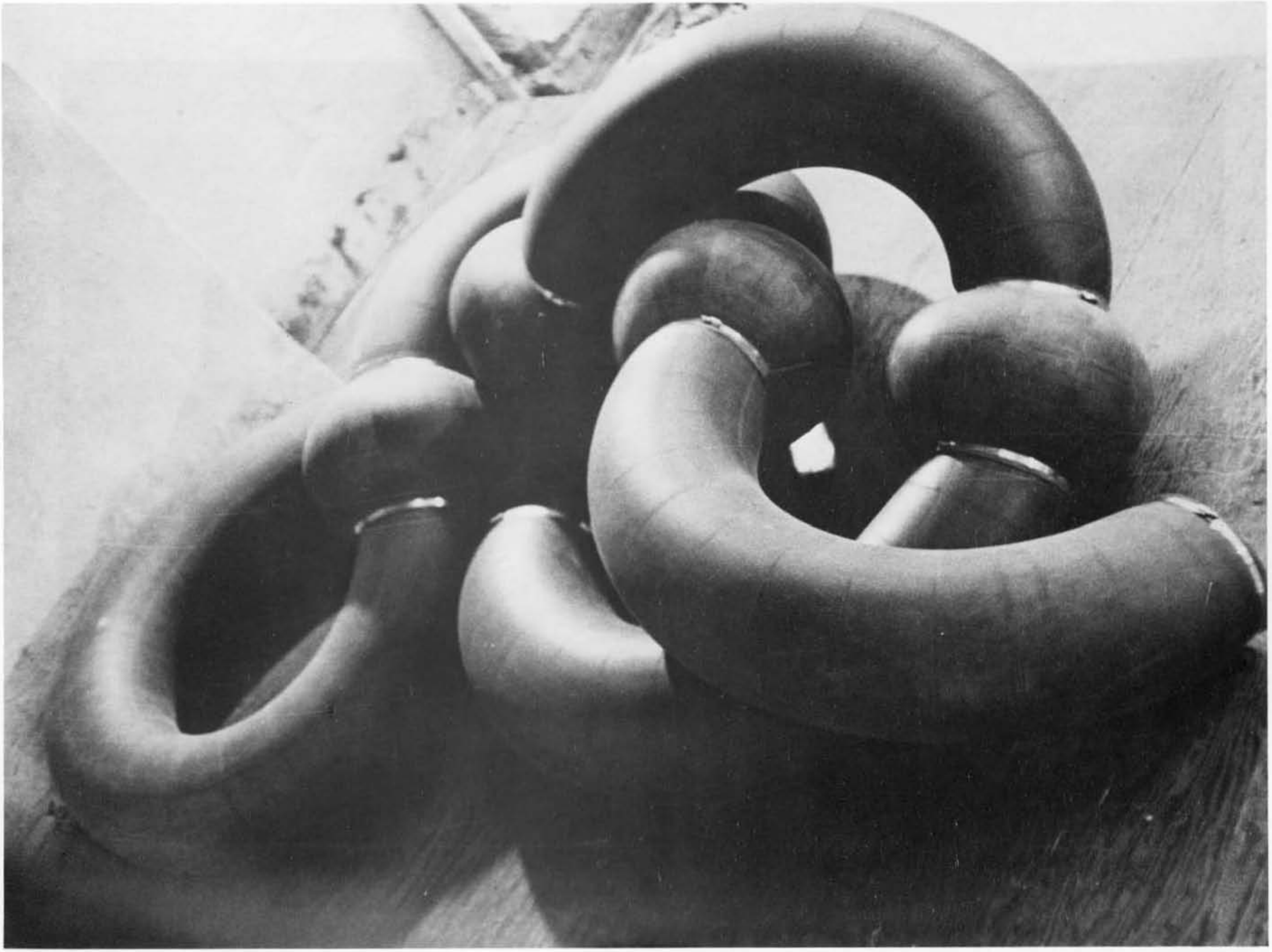

HOROSCOPE PROGRAM
JAN 28 1970

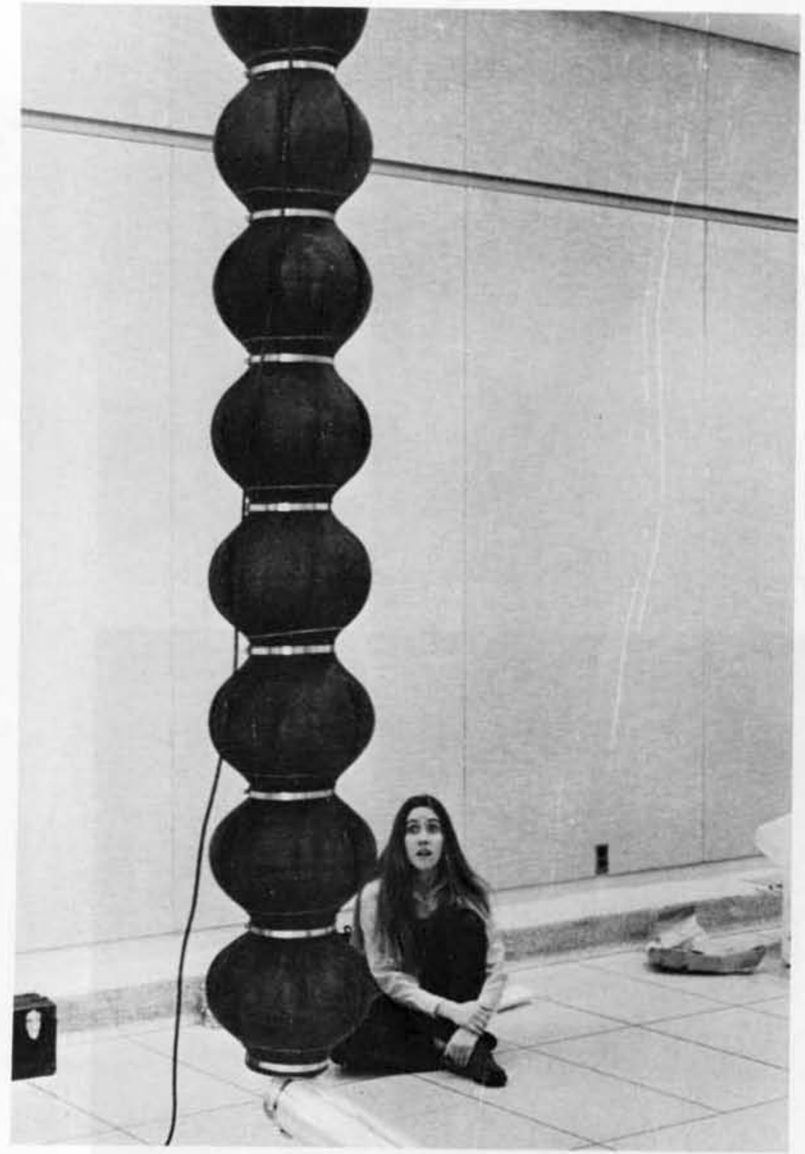

SWEEPER
PAINTER
SQUEEGER
DRAWING MACHINE

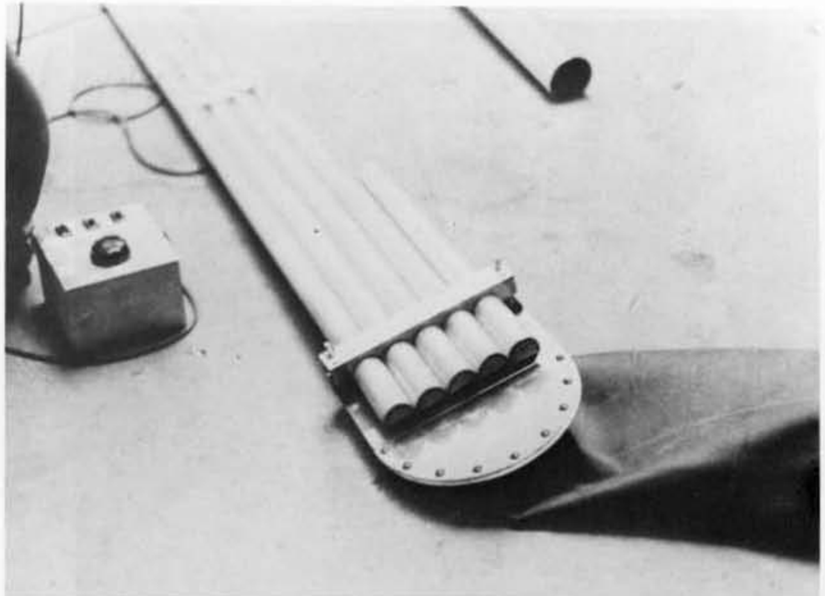



A
B
C
A
B
C


clothes
cornell
Sculpture House
FEB 6 1970
Pug called will come at 3ish
CHRISTOPHER
WINTER
PUGLIESE'S
FIRST DRAWING
AGE 14 MONTHS



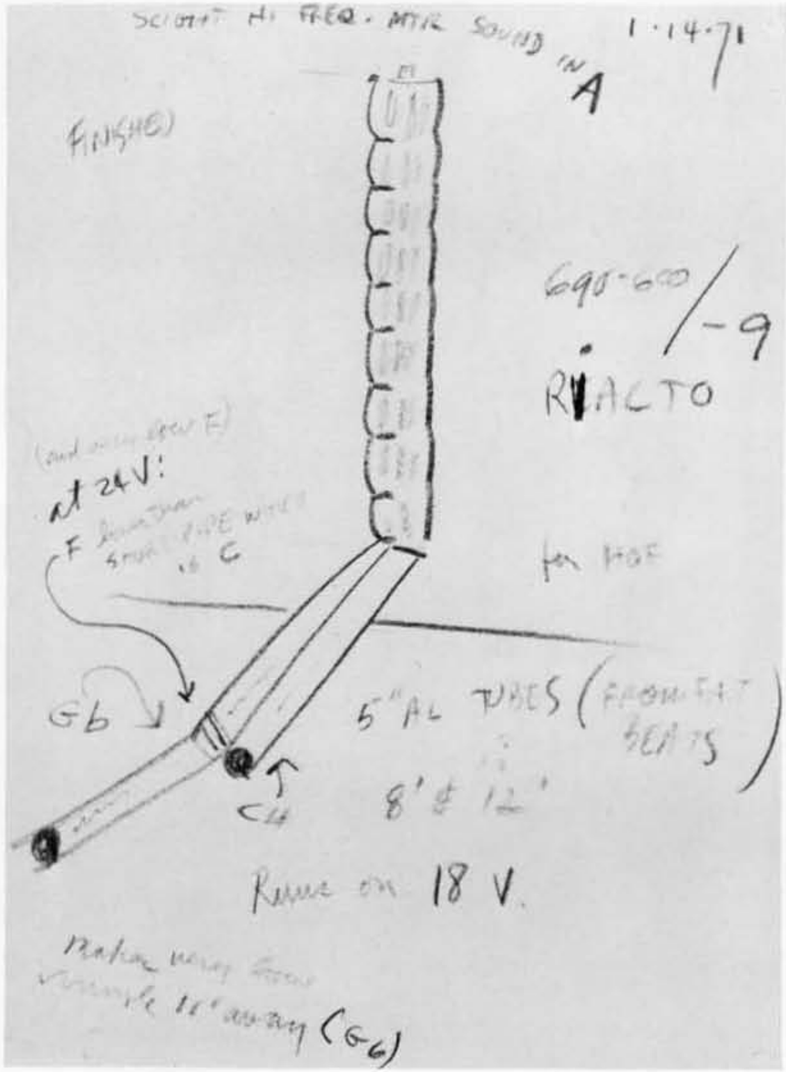




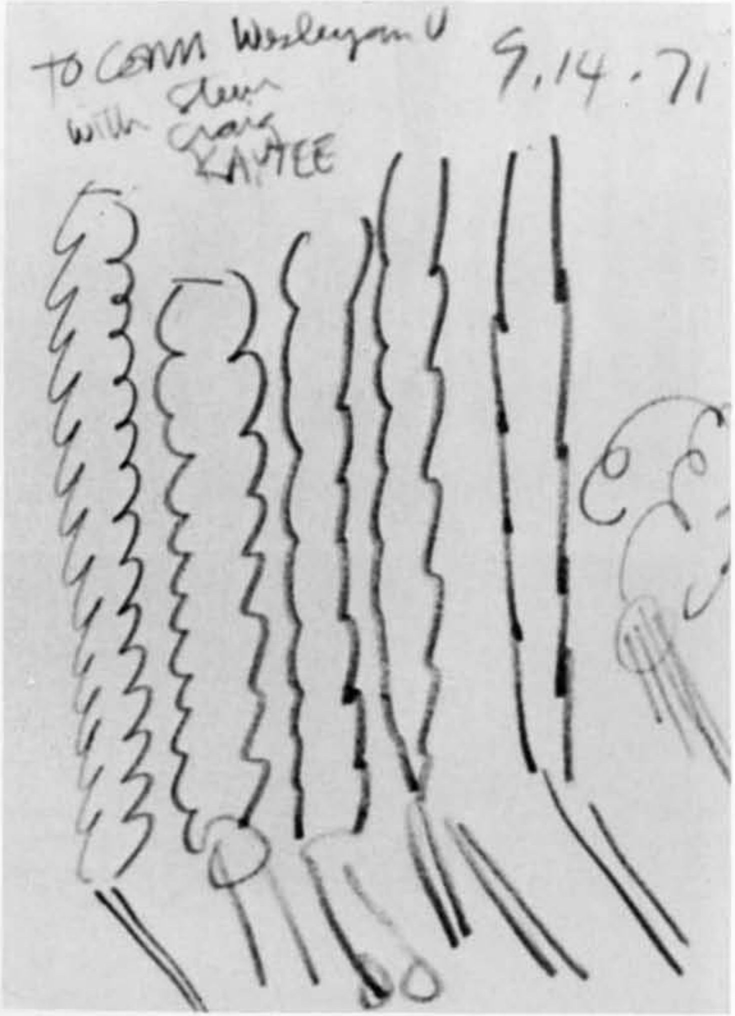
in GÖRLITZ a lion roars
— 8 PIPES OF DIAPHSON REGISTER
tuned D, D#, F, G#, A, D, D#, F
worked by elec. bellows

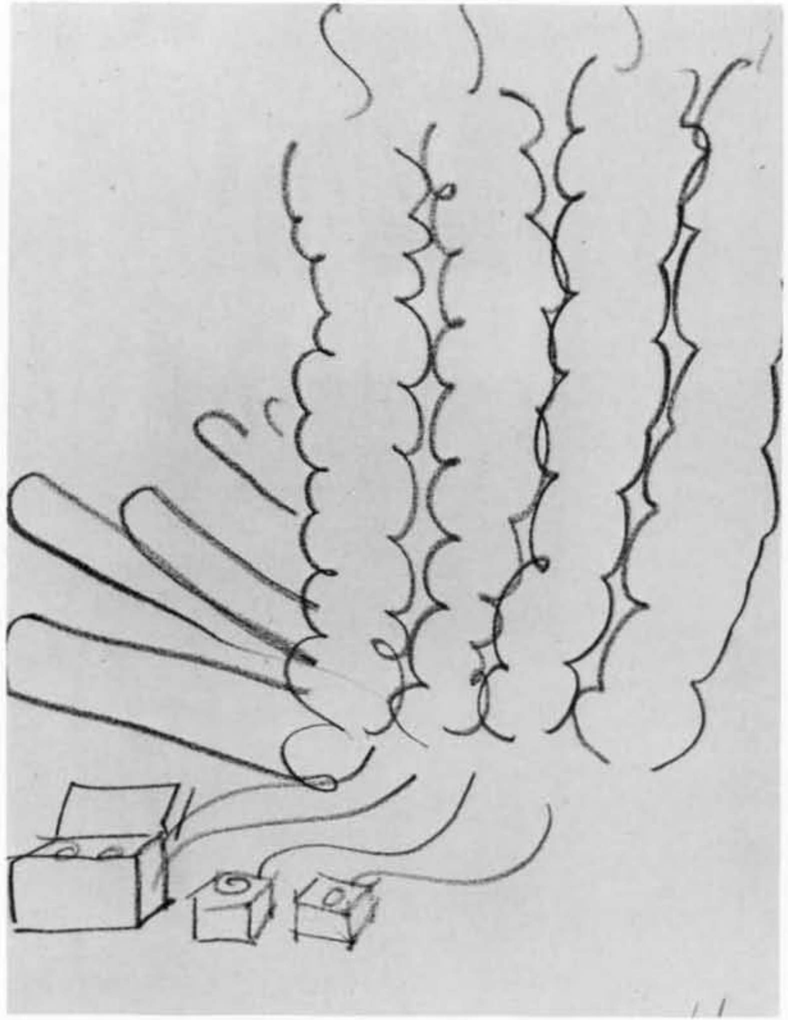
---

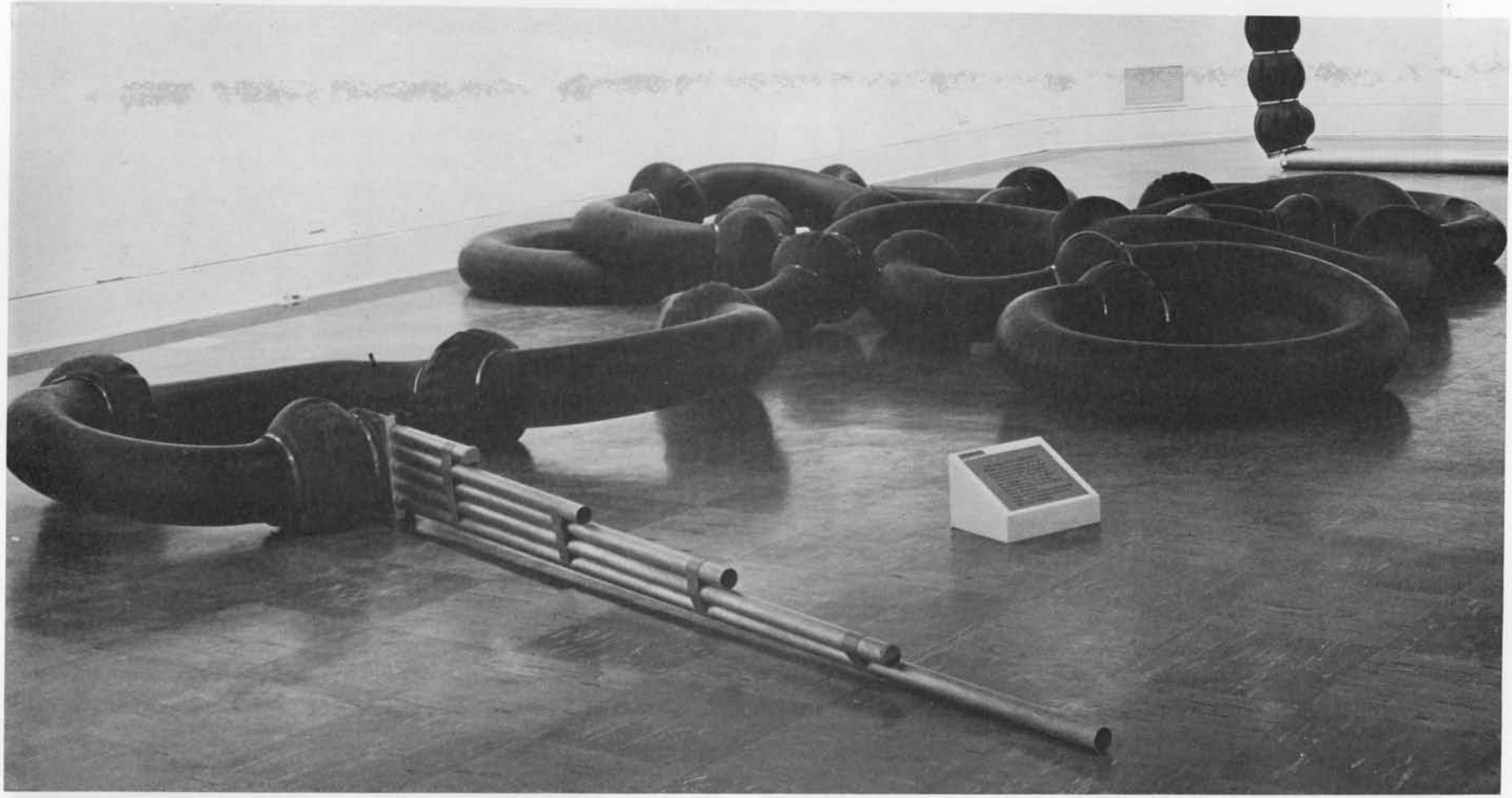
a barrel organ exists
in use in little church
in SHELLAND near STOWMKT.
& BARNSTON near DUNMOW
BBC DID BROADCAST OF
EACH !


1.14.71
A
FINISHED
690-600/-9
RIALTO
at 24V:
Gb
C4
5" AL TUBES
8' & 12'
Run on 18 V.


1.15.71
3) 24V TRANS. 2.5 AMP
2 5AMP MTRS
RUN AT 2.5 AMP
AT 25 V.
WIFF WIFF BEATS
ON C


TO CONN Wesleyan U
9.14.71
with Steve
Craig
KAYTEE





Page 36 February 1967. (8¼x10¾ drawings) These two pages show how I added towers of clinking clacking aluminum to a flopping element designed by Charlie Frazier in what was to be a collaborative presentation with Herb Deitch and his group of musicians. Frazier's flopping base, a prototype of two hover craft he made for Allan Kaprow's Happening "Gas," was unstable and could not balance the towers I built. The last drawing shows how I turned the whole thing upside down, added a platform on top the flopper, and added a stable base. The air (generated by a vacuum motor and fan) pushing against this platform escaped through small holes into which I thrust small organ pipes.

Page 37 February 1967. Another immediate addition seen here is the integrating for the form of black joined inner tubes.

Page 37 February 1967. Without a doubt this is the moment of birth of an integrated inflating, sounding, form.

Page 38 March 1967. Although I had made several other sound sculptures as early as 1957, this body of work was born under the same sun sign as I and seemed to me very appropriately shaped.

Page 38 March 1967. Polaroid photos of the first completed sound piece which I've always called "Mother." This piece was improved somewhat when re-built later in the summer.

Page 39 March 1967. Photo, Barbara Bernal. Taken in the Wah Chang Tungsten Refinery in Glen Cove, Long Island where Frazier (middle row right) and I had studios. The sculptures in the foreground are Frazier's, and Professor Herbert Deitch, a colleague of mine at Hofstra University, is playing the trumpet.

Page 40 May or June 1967. Allan Kaprow's drawing in my book suggesting a method for programming the several pieces I had made by this time. This bumped disc switching system was one he had used while investigating apparently random systems while he was studying with Cage, I believe.

Page 40 March 1967. A cut stretched inner tube emitting reed vibrations. Used in the second piece I refer to as "Pop."

Page 41	April 1967. A smacking force reminding me of Brancusi's "Kiss," this became "Breather," a rhythmically inflating piece of escaping air sounds.
Page 41	August 2, 1967. Somewhat revised this idea became "Champ," a sometimes grunting piece.
Page 42	August 23, 1967. The air system for "Horn," an offensive blasting piece.
Page 42	September 1967. Photo, Michael Fales. The group of nine performing sound sculptures which appeared in the Emily Lowe Gallery at Hofstra University as "The Wah Chang Box Works Assyrian Air Fair." Each piece had an electromechanical program (timer) which I could thwart at a console. At this series of performances I used colored lights, slides, films and taped factory sounds to create an environmental effect. I used these audio, visual elements finally at the D'Arcangelo studio performance in December also.
Page 43	August/September 1967. Programming system as used for work described above. Series of three four-switch timers interrelated so as to prolong pattern. The first timer on the left was an ancient one with a flywheel slowed by a variable magnet making possible slower or faster programs in four pieces.
Page 43	Portion of the invitation to the series of performances held in New York in November and December of 1967.
Page 44	August 13, 1967. Visualization of electrical connection from timer to outlets.
Page 44	June 4, 1969. A poem relating to my life in a rubber factory in San Clemente, California circa 1951.
Page 45	April 30, 1969. I thought I'd discovered something pretty important when I stretched rubber over a pipe attached to a blowing vacuum cleaner motor and placed the rubber lips against my cornet.
Page 45	Fall 1970. Imagine my embarrassment when I discovered that a mechanical bugler with rubber lips had been made in 1810. Sketch from a beautiful color photo in Buchner's Mechanical Musical Instruments, Batchworth Press, London.
Page 46	May and June 1969. Drawings developing a mostly rubber exhaust sounding piece described below.
Page 46	June 1969. "Floor Piece." Collection: Vera List.

Page 47 In Fall of 1970 I was granted a semester leave from Hofstra University where I have taught sculpture since 1962. During this sabbatical I read at various libraries in New York. The music library at Lincoln Center as well as the Free Library of the General Society of Mechanics & Tradesmen of the City of New York were good places for me to find out about some of the phenomena which I had discovered in the studio. I began by trying to trace the history of programming from the early barrel organ through other mechanical musical instruments, androids and automata, the Jacquard loom, street organs, the Link trainer of World War II, and switching devices, to the computer. All are based on a switch which is "on" or "off" whether it's a log with nails in it tripping organ keys or a card with holes in it letting threads fall onto the weaving pattern of a loom or a paper piano roll causing a blinking message on the underside of airplane wings or a punched paper roll switching a motor in a factory. Winkel's Componium (a composing machine made in 1821) could play without repetition for 138 trillion years.

Page 47 A programming switch like one used together with thwarting buttons for the three pieces which appeared as "Mothers Mechanical Wonderful Wah Wah" at 'Options,' Milwaukee Art Center and Museum of Contemporary Art, Chicago in 1968. This programming switch, widely used in industry, consists of a cylinder with 60 grooves which rotates completely in a minute. Each groove may contain a moveable plastic peg which can actuate a microswitch each second. The length of program in this case is, then, one minute for each switch (a single motor may drive a unit containing as many as 57 switches, each switch being separately programmed by the plastic pegs.) Of course this useful principle is that of the barrel organ and the music box. Variations on this system include lengthening the program by causing the cylinder to move laterally, permitting another row of pegs to actuate the switch.

Page 48 Photo, courtesy Jewish Museum. View of some of the pieces which were included in the 'Inflatable Sculpture Exhibition' at the Jewish Museum the summer of 1969. In the fall, the whole exhibition traveled to the Witte Memorial Museum in San Antonio. In the winter, a slightly different selection under the title "Wonderful Wah Wahs" performed at Colgate University.

Page 49 1970. Photo, Hugh Rogers. Steve Hendirckson and I working in my 13th Street studio.

Page 50 1969. A stack of three microswitches and a 5-rph motor of the kind available from surplus outlets. These switches and motors are very durable and rarely fail even though they may have seen ten or more years of service. Automatic dish and clothes washers also yield very usable parts.

Page 50	January 28, 1970. At top left is the tracing of a metal disc with one notch which can actuate a microswitch. Below, my natal horoscope is superimposed and niches cut out corresponding to the arrangement of planets. This is the program of the small piece I call "Self Portrait."
Pages 51 - 52	February 1970. A "drawing" and later "painting" machine which made the graph-like drawings in which we see both the simple program and the simple resultant "drawing." Later developments added variable voltage and therewith a "how much" on or off possibility. These and other developments made a greater apparent distance or difference between the program disc input and the output or product. Nevertheless, it was not without interest that I read "Man is a Machine" by Woolridge.
Page 53	This photo signals the beginning of the change from reed sounds to vibrating air column sounds. This floor piece was planned for construction at San Jose State College by myself and students during May of 1970.
Page 54	May 1970. The San Jose piece emitted sound of an excited air column in aluminum pipe ten inches in diameter and twenty feet long. A large rubber construction inflated slowly, causing a very low fundamental note first, then other higher partials till the highest was reached as the serpentine rubber tubes were engorged with air. The piece then deflated and the sounds dropped in volume and pitch till all was silence.
Page 55	Photos, Justin Kronewetter. I can be seen operating a variable voltage unit controlling the speed of motor and fan housed at the top of the rubber portion. Here and hereafter I have used both or either manual controls and programmed controls.
Page 56	A five-pipe sounding unit composed of 2-, 4-, 6-, 8-, and 10-foot pipes two inches in diameter. This piece was first played at Cornell University's Sibley Dome in spring 1971. A manual variable voltage control is seen at the left.
Page 56	1970. Photo, James Hendrickson, Jr. Left-to-right: "Ashleigh" Gibbons, my first apprentice from the Great Lakes Colleges Association Arts Program, me, Steve Hendrickson, another GLCA apprentice, and Richard Wengenroth, painter and Director of GLCA Arts Program in New York.
Page 56	Fall 1970
Page 57	Dated 1971. I called this piece "Blue Rialto" after the brand name of the innertubes I made it from. "Blue Rialto" produces most satisfying beatings and difference tones. The pipes are five inches in diameter, are 8 and 12 feet long and the 8-foot pipe is half-stopped. "Blue Rialto" was first shown at Hofstra University's Emily Lowe Gallery in 1971, erroneously albeit playfully titled "Bobby."

Page 58	Dated 1971. A drawing of hanging pieces in anticipation of the Wah Wah at Cornell's Sibley Dome.
Page 59	April 1971. Photos, David Jacobs, Jr. Listeners at Sibley Dome. During the day all pieces were operating at a constant gently beating low volume. From 4-6 p.m. on each of three days a crowd gathered for a "concert performance."
Page 60	Photos, David Jacobs. Sibley Dome, Cornell.
Page 60	Student musician playing with Wah Wahs.
Page 60	Robert Moog at the "console" of the Wah Wah.
Page 60	Young people responding physically to an inflated Wah Wah.
Pages 61-62	February 1972. Photos, Todd Greenaway. Wah Wahs at the Vancouver Art Gallery

Reinhold Pieper Marxhausen

REINHOLD PIEPER MARXHAUSEN

Born 1922 in Vergas, Minnesota. Studied at various art schools, institutes, and universities throughout the mid-western United States. Received M.F.A. degree 1962 from Mills College, Oakland, California. Has exhibited widely since the early 1940's, and is the author of many articles on art and related subjects. Currently Chairman of the Art Department, Concordia Teachers' College, Seward, Nebraska.

Variations on the Theme for Listening to Door Knobs

MILK FOR MELODIES

Childhood in prairie country was a delightful experience. The open spaces, the parsonage with eight children, three cows, pigs, dogs, cats, large garden, and so much silence one could hear the grass grow.

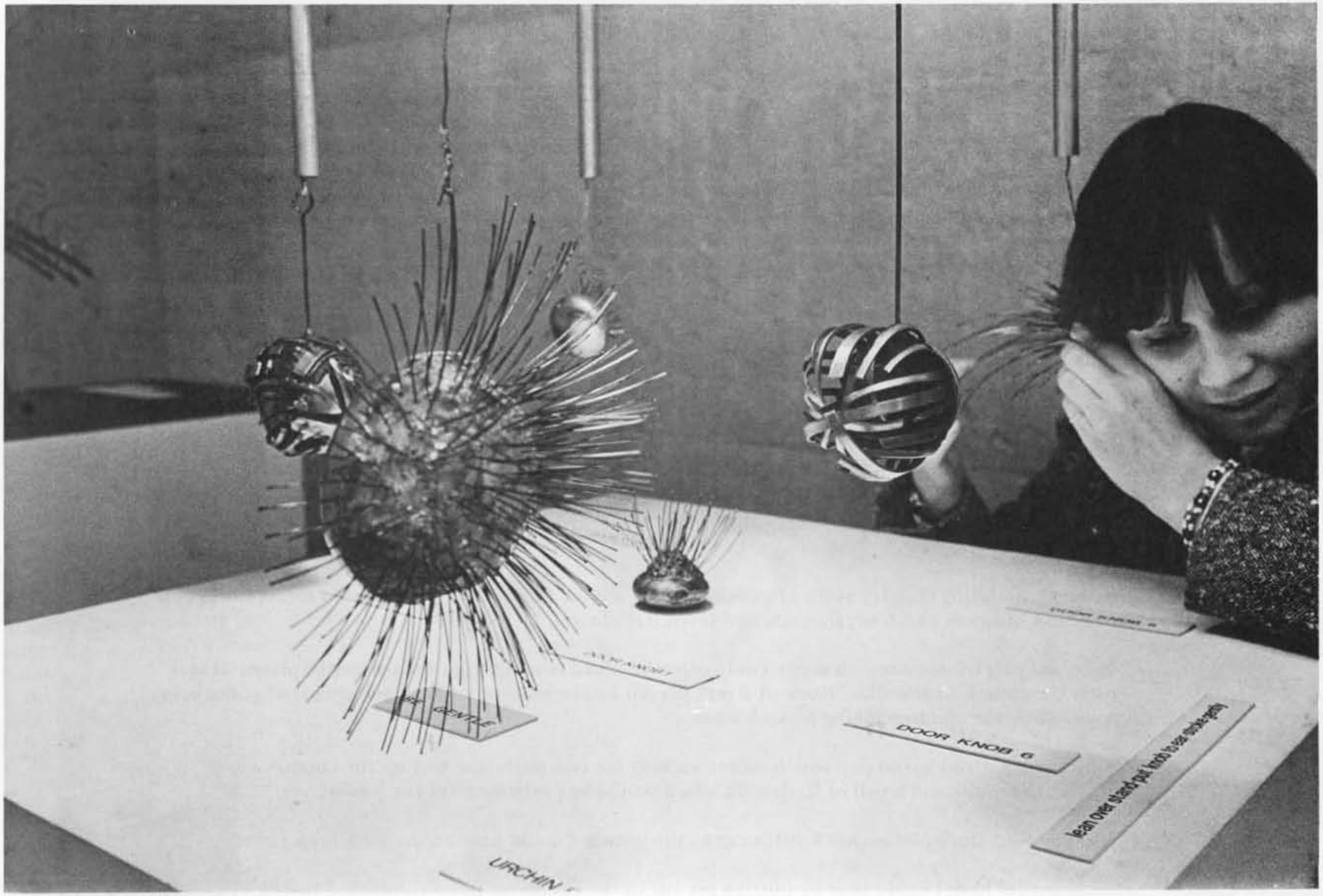
Herding cows along country roads after school, gave me the time and opportunity to amass the largest collection of agates and four, five, six, and seven leaf clovers.

Music was part of worship. So music could often be heard coming from the parsonage piano. It was either the church hymns like "Rock of Ages" played by the mother, or the rigid sounds of scales being practiced by the children taking piano lessons.

Saturday was piano lesson day which meant walking for two miles one way up the country road carrying the music and a pail of fresh milk which would be exchanged for the lessons.

The sounds of the scales sounded stiff next to the sounds I could hear on the walk back home.

The beautiful hum I could hear by putting my ear to the telephone poles stimulated visions of people talking to each other from Minneapolis to China.


GENTLE
DOOR KNOB 6
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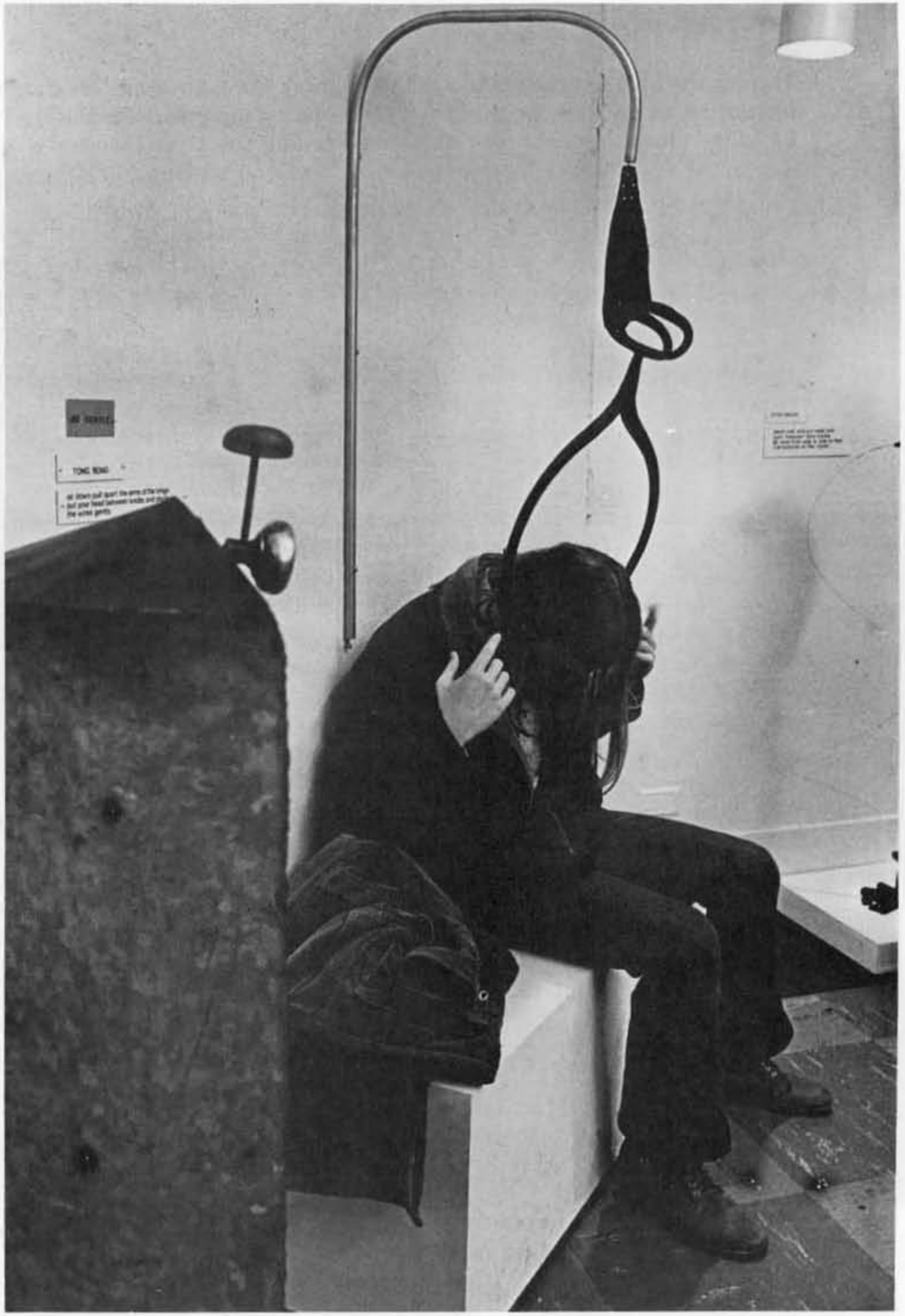


BOTTLED MUSIC

Playing the scales on the piano in the country can be boring. Hearing someone play some whiskey bottles on an amateur hour on the radio one evening was stimulating. Whiskey bottles could easily be found along any country road while herding cows. So I gathered up as many as I could without my father knowing it. Testing was done while father was gone visiting the members of his parish.

Tuning is easy. Begin with a bottle. Hit the side with a stick and check to see what note it is. By adding water, the note goes lower. Add or subtract water until you get the note you want. A whole scale can be done with the same size bottle. Flat bottles are better than round ones and flat rounded "hip bottles" have the best tone of all.

How do you approach a minister father with an instrument made of whiskey bottles? By first practicing a lot. In the corner of the garage enough practice went on so that the first encounter between father, son, and whiskey bottles would receive a favorable response . . . even if the tune was "Twinkle Twinkle Little Star."

From the low, water-filled quart whiskey bottles, up to the small medicine bottles, four octaves are easily attained. The quality of the notes is determined by the size of the bottle and the amount of water in it

Build a wooden frame a little taller than eye level. Put screw eyes in the wood. Suspend the bottles with string from the screw eyes. Arrange the notes like a piano. Naturals lower and in the back row, and sharps and flats in front of and a little higher. A string in back of each row will keep the bottles in place and prevent them from swinging or turning. Mallets are easy to make of wood and felt or rubber.

The bottles could merely be placed on a table and played that way, but the tone is so much better when suspended.

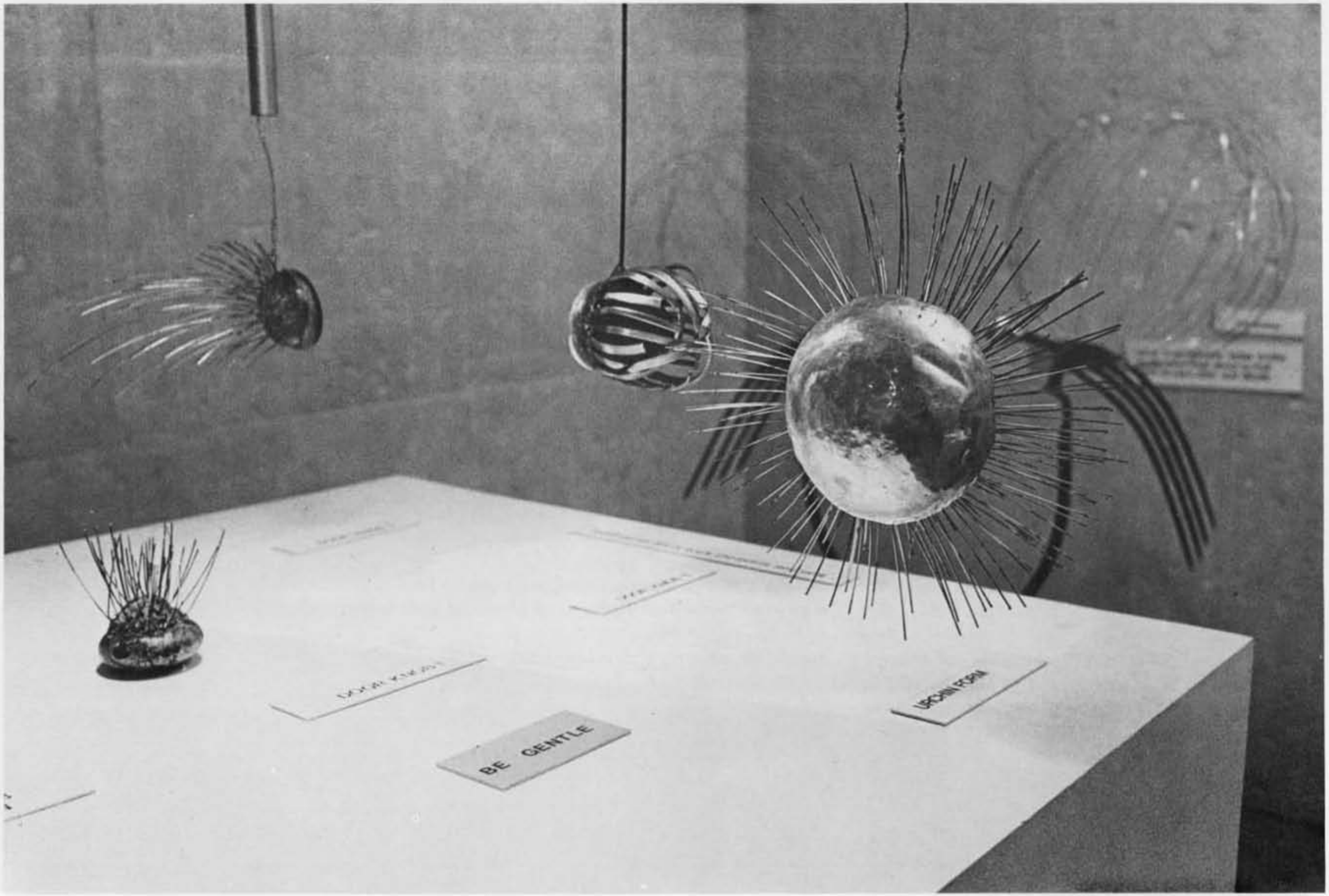
Touring Minnesota as a teen ager and performing for any and all groups was a free experience even if the tunes were "Bells of Saint Mary" and "Beer Barrel Polka."

Then I learned to play the carpenter saw.

C MELODY SOUND

Music instructors and band directors tend to have strong feelings about which instruments are to be more acceptable than others. As a freshman in Lewistown High, I bought a C Melody Sax from the band director. I played it in his band.

The next year I transferred to Austin High. The first day in band I asked the director where I should sit with my C Melody Sax.



Reinhold Pieper Marxhausen

Marxhausen

"Your what?" he raged in utter disbelief.

When we were all seated he managed to embarrass me in front of the whole group by saying, "Some idiot sold this young man a C Melody Sax and he should be hung at sunrise." He went on and on and I felt bad.

I felt worse in the months that followed. The director allowed me to sit with the regular sax people . . . but there was little C Melody sheet music so I had to use Oboe, Bassoon, E flat Alto, tenor or whatever music was left over.

I learned to transpose music, but mostly I learned to play by ear.

IT'S ONLY A SAW

The Khatchaturian piano concerto calls for 32 measures of flexeton solo. When the Lincoln Nebraska symphony selected to perform this, there was a search for a much needed saw player. Since competition is not that keen in Nebraska, I was suggested and passed the audition.

A violinist played my part and recorded it on cassette tape. By playing the tape over and over again in my basement, while looking at the sheet music, I could memorize the part. Here and there I would put a pencil mark on the edge of the saw blade to give me some indication of where some notes were.

Saws have different sizes, shapes, number of teeth. Thickness of metal, kind of metal, and width of blade all make a difference in tone. The blade I use has been worn down by much cutting and filing. The wooden handle hardly exists and it was bought at a Nebraska auction sale for 10 cents. The students used it for cutting plaster of Paris before I discovered its beautiful, rich, sound quality.

The director had a hard time hearing me play. When he asked the first violinist whether he could hear it, he replied that he could hear it but he doesn't believe it.

Think of all the money spent on buying a violin, the funds expended for all the lessons and countless hours spent to be able to play it well. And then finally to be able to play in the symphony.

The elderly woman in the violin section sitting next to me had an expression of stony resistance and disbelief at the first day of practice. She looked at me and almost cried as she quietly and sadly said, "It's, it's only a saw."

I did not reply, "You only have a violin."

ONE DAY WHILE LISTENING TO A DOOR KNOB

The sculpture studio had only one person, besides me, working in it. My plans were to construct a piece of sculpture with sun, moon, and stars as metal elements. The work was begun by welding wires to a round metal object. At this point a strange curiosity overtook me. When the other person was not looking, I placed the object to my ears and strummed the wires. Wow!

The yet unheard of, unearthly, indescribably beautiful and haunting sounds came from the hollow chambers of a door knob. Intimate sounds only heard by the player. Sounds that have made a nun dance, old people laugh, and everyone smile.

Back to the studio. Weld more wires on another knob. Join the two together by a steel band. Stereo!

The object looked menacing and dangerous. The potential listener is afraid and expects the worst. Instead, the resulting sound is one of the most pleasing experiences one can have. All outside sounds are eliminated. No wasted vibrations for ears that don't listen. The participation in this object is a kind of curiosity fulfilment. The planned sculpture never became a reality. Because I found something much more interesting.

When you can listen to a door knob, you are free.

PICKETY WICKETY CLICKITY CLACK

A picket fence does not have to look even. It can be uneven just as well. When it is uneven, the sound will be more interesting when the neighborhood boy comes by with his stick to drag along the staves.

Long sticks make low notes. Short sticks make high notes.

Cut the sticks and tune them. Arrange them so a recognizable tune can be played.

Let the boy and the neighborhood discover that the fence has a tune.

Let the Neighborhood discover why the fence looks so uneven.

Change the tune each year.

Make a wooden fence in a circle. Tune the interchangeable sticks so you can play a round. Three children running around and clacking the fence at the same speed can play the round.

RAIN DROPS

The rain water runs down the shingles on the studio roof. It flows over the rough wood surfaces and sometimes it runs in the grooves between. Suddenly there is the roof edge and the long drop down– to the studio decking. The sound of the drop on the wooden floor is very soft and can hardly be heard.

One day a tin can got in the way of a drop and the sound was loud and delightful.

Many cans of various sizes were placed along the roofline so that the drops would hit the can bottoms. Wow.

Some drops came down fast and some slowly. Different cans, different sounds, different speed and beat. On a good rainy day 30 cans in a row can really make a neighborhood sound. As the rain slows down the beat changes. Make a rainy day worth listening to. Cardboard boxes or other materials would have a different quality of sound. Combine different materials.

Keep extra cans and boxes around in case it rains. If you do not have a roof to call your own, set up a piece of cardboard or plywood on a slant near your house and catch the drops as they run off the edge.

Make a rainy day worth listening to.

DELIGHT

Breaking the sound barrier is as important as breaking the sight barrier. The sounds we accept are as stereotyped as the sights we call beautiful (pretty). Maybe the word delightful can better describe the response that is needed in order to have a significant relationship to sight and sound.

Delight should be man's response to art as it pops up unexpectedly here and there in our environment . . . as man creates it or as it is found in nature. One never understands art or art forms and responding comes only when we are fully awake and alive.

Delight is satisfying, immediate, better than cute.
Delight is filled with joy, spontaneous, accidental.
Delight is irrational, irreverant.
Delight is to expect the unexpected.
Delight is a giggle unexplained.

Delight never happens when you know too much.

The sounds we will accept are almost as stereotyped as the sights we will behold. In the arts, any kind of elitism prevents man from responding as a human being rather than as a cultured person.

BOTTLED BUTTERFLIES

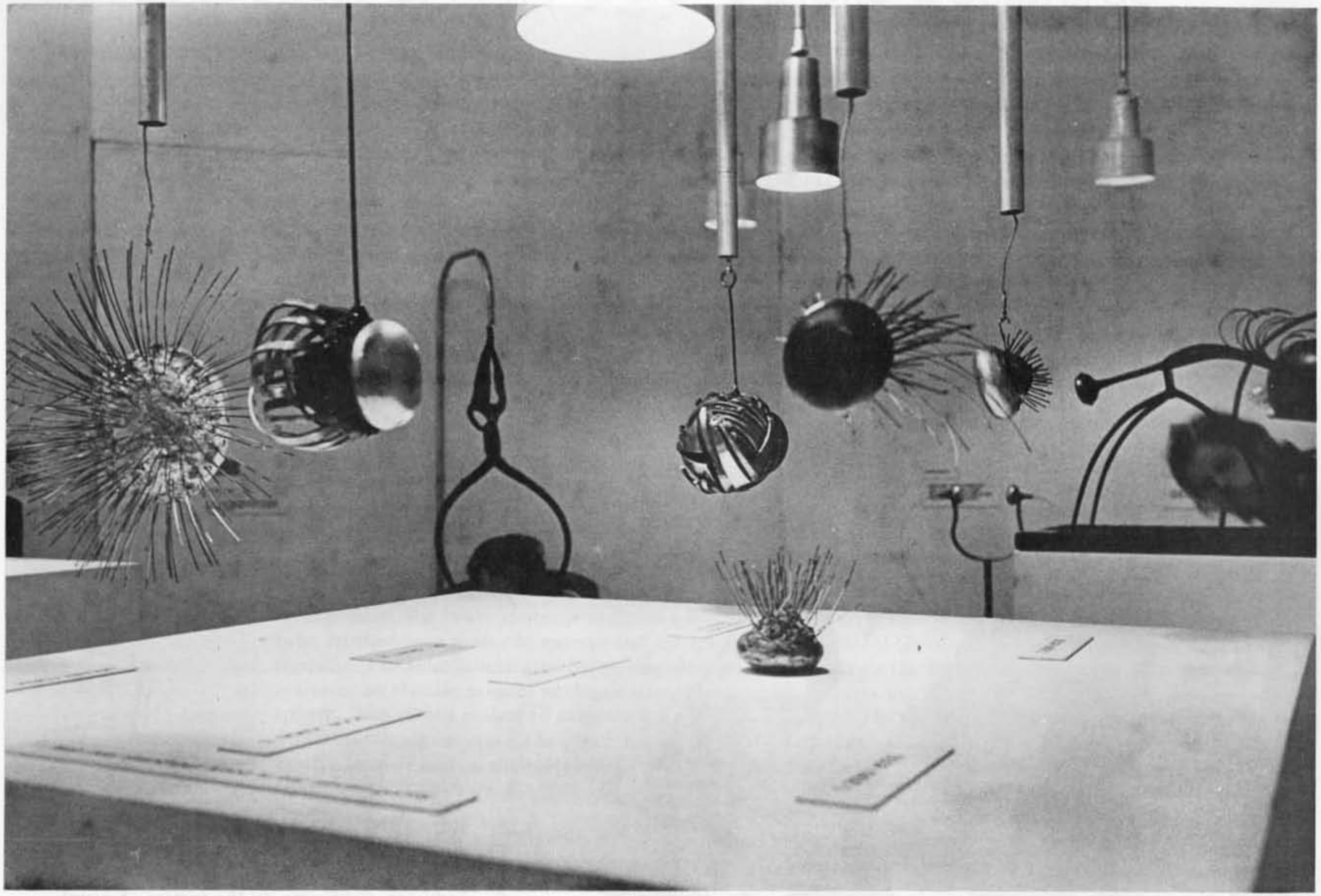
He who binds himself a joy
Does its winged life destroy.
He who kisses a joy as it flies
Lives in eternity's sunrise.
William Blake

The little boy's two hands were closed tightly. They held something valuable. He said he had some butterflies. What good are butterflies when they are in a fist?

Do you really have butterflies in there? He nodded . . . and asked for a jar.

But butterflies need the sun and the flowers and the fresh air and the sunshine . . . and I don't believe you have butterflies in your fists. A trick.

The little face looked up with an expression that would dispel disbelief. Grudgingly the two fists slowly opened. Unbelievable! Seven beat up butterflies flopped about the fresh air like sheets of plywood in a hurricane. How does a small boy capture and contain seven butterflies in his fists? The same way adults fill their lives with things that will look good on the mantle.



Marxhausen

CHARLES MATTOX

Born 1910 in Bronson, Kansas, studied with Arshile Gorky and worked with David Smith in the thirties. Special effects man in the film industry, California, in the forties. Several one-man shows and group exhibitions in both North America and Europe. Currently Professor of Art at the University of New Mexico.

The Evolution of My Audio–Kinetic Sculptures *

DISCUSSION OF MY SCULPTURES

Building sculpture with those considerations in mind, we are faced with some of the same problems that are a part of a machine culture. Sculpture designed to move or be moved with motors and electronic parts has a short life span as compared to traditional sculpture. I feel this is as it should be, and I am willing to accept the fact that my works will have to be serviced, refinished and finally be expended. [2-4]

This does not mean that the pieces are not well-built and finished with great care. All the large forms are fiberglass covered and finished with eight to twelve coats of automotive lacquer. The metal parts, wherever possible, are machine-finished or chrome-plated. I usually use primary colors and have found many standard automotive colors that suit my needs. For exterior pieces, I have been using either epoxy, which is very difficult to handle, or vinyl floor finish, which stands up well but does not have a wide range of colors.

Several years ago I made a series of pieces that were non-machinelike in their effect, in spite of the use of motors and magnets, highly finished surfaces and geometric shapes. 'Act of Love' was one of the first of these. Figure 1 shows one of the drawings from which the sculpture was constructed. A small red ball detaches itself from the parent ball and moves toward an 'erogenous zone' on the neighboring ball. It crawls around the zone for a while and then returns. The metal parts are stainless steel, polished and machine-finished. Activated by the top motor in the large sphere through a cam and spring arrangement, the lower motor is made to move through an arc. This action causes the flexible plastic tube on the lower motor to extend and retract through a hole. This tube has a small red ball at its extremity. The tube is activated by closing the mercury switch on the lower motor. This switch also activates an electric magnet in the smaller sphere which attracts the turning ball issuing from the large sphere. The motor is slow (4 minutes for a complete cycle). The effect is very erotic and has a great deal of randomness in it. The piece is built of plastic and stainless steel. The two spheres are black automotive lacquer and all the metal surfaces are machine finished. The small red ball is the only spot of color.

A similar machine is the 'Blue Seven', 32x18x15 in. in size. It consists of an upright figure that looks like the numeral seven. It sits at one end of a red platform and very slowly begins to tilt toward a large black sphere sitting on the other end of the platform. When the seven almost touches the ball, the ball jumps and buzzes, whereupon the seven shape retreats to its former position and stops.

*Excerpted from Leonardo, 2, Autumn 1969.

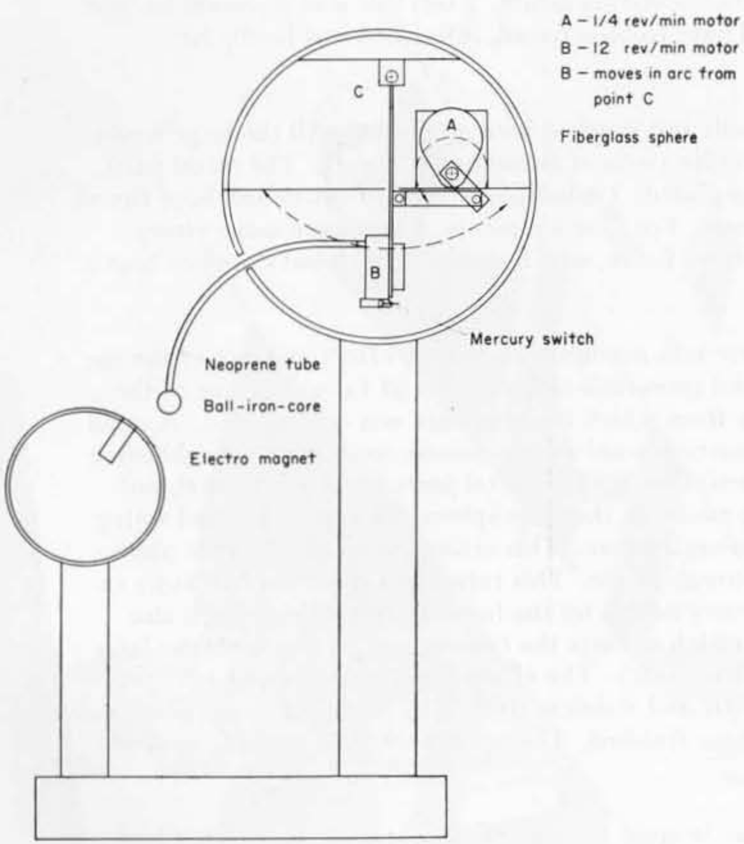
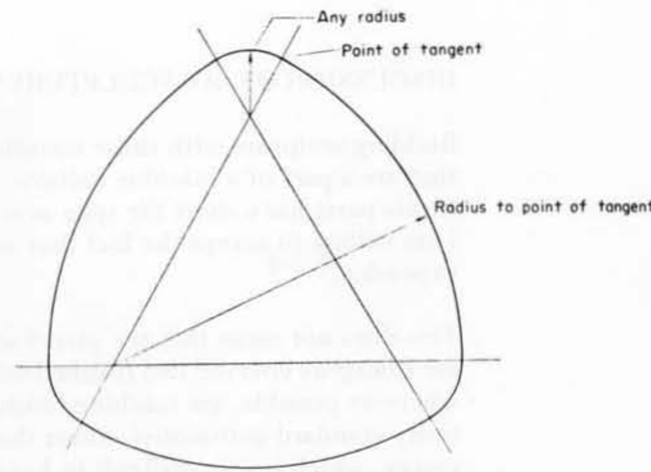


Figure 1



Reuleux based on equilateral triangle sides of triangle are extended x distance

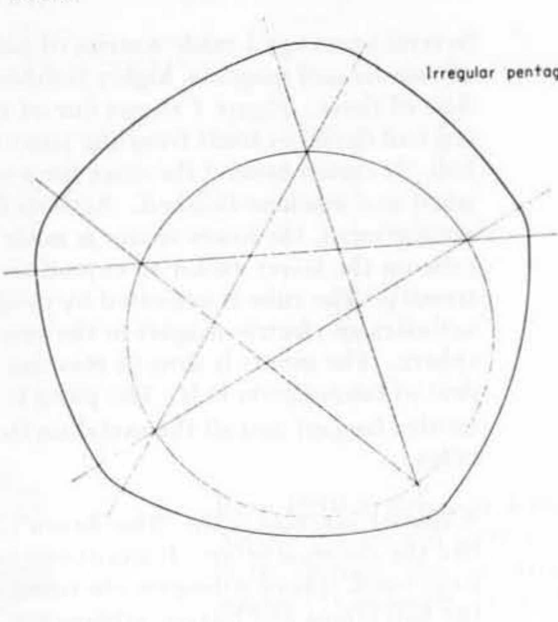
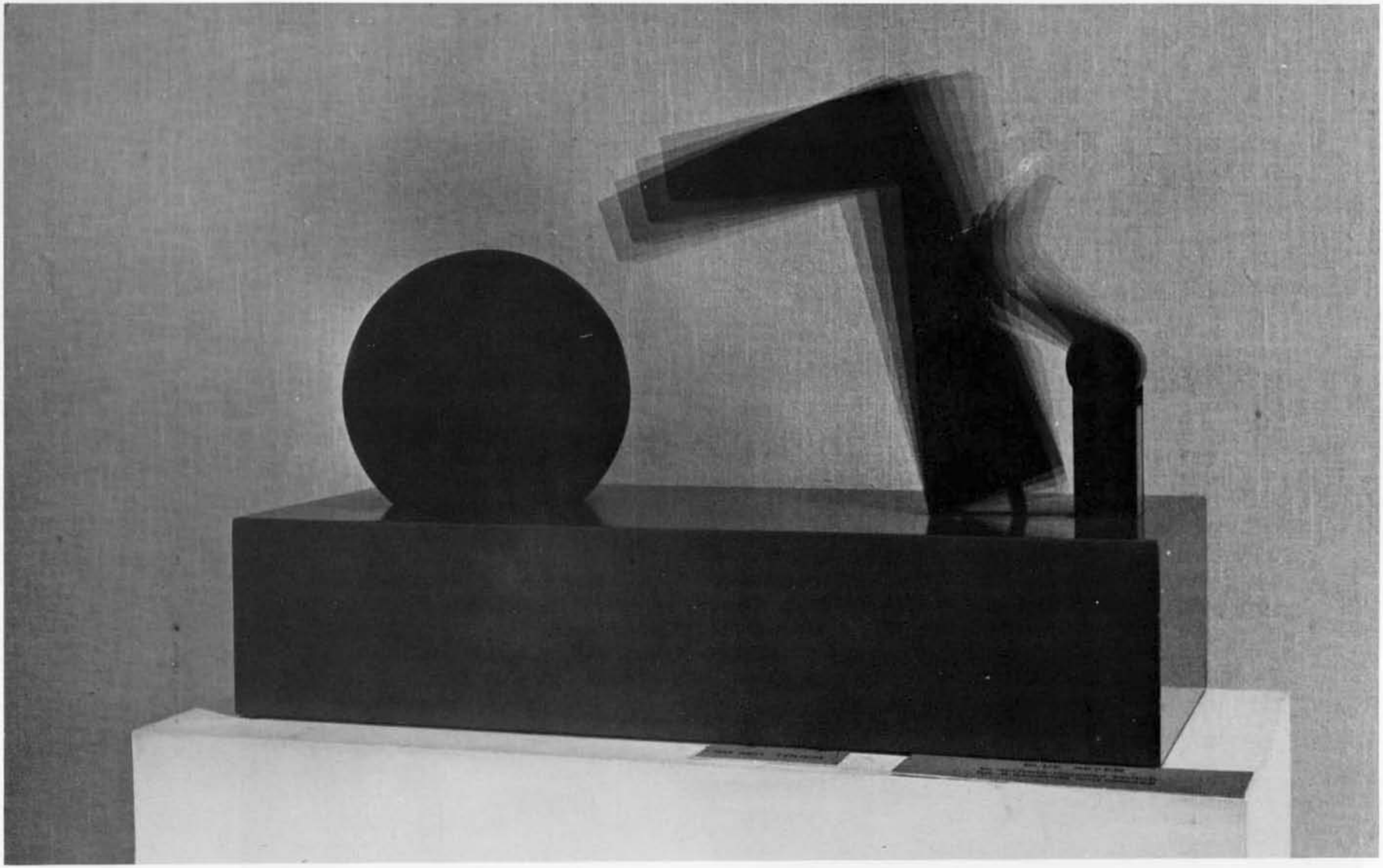
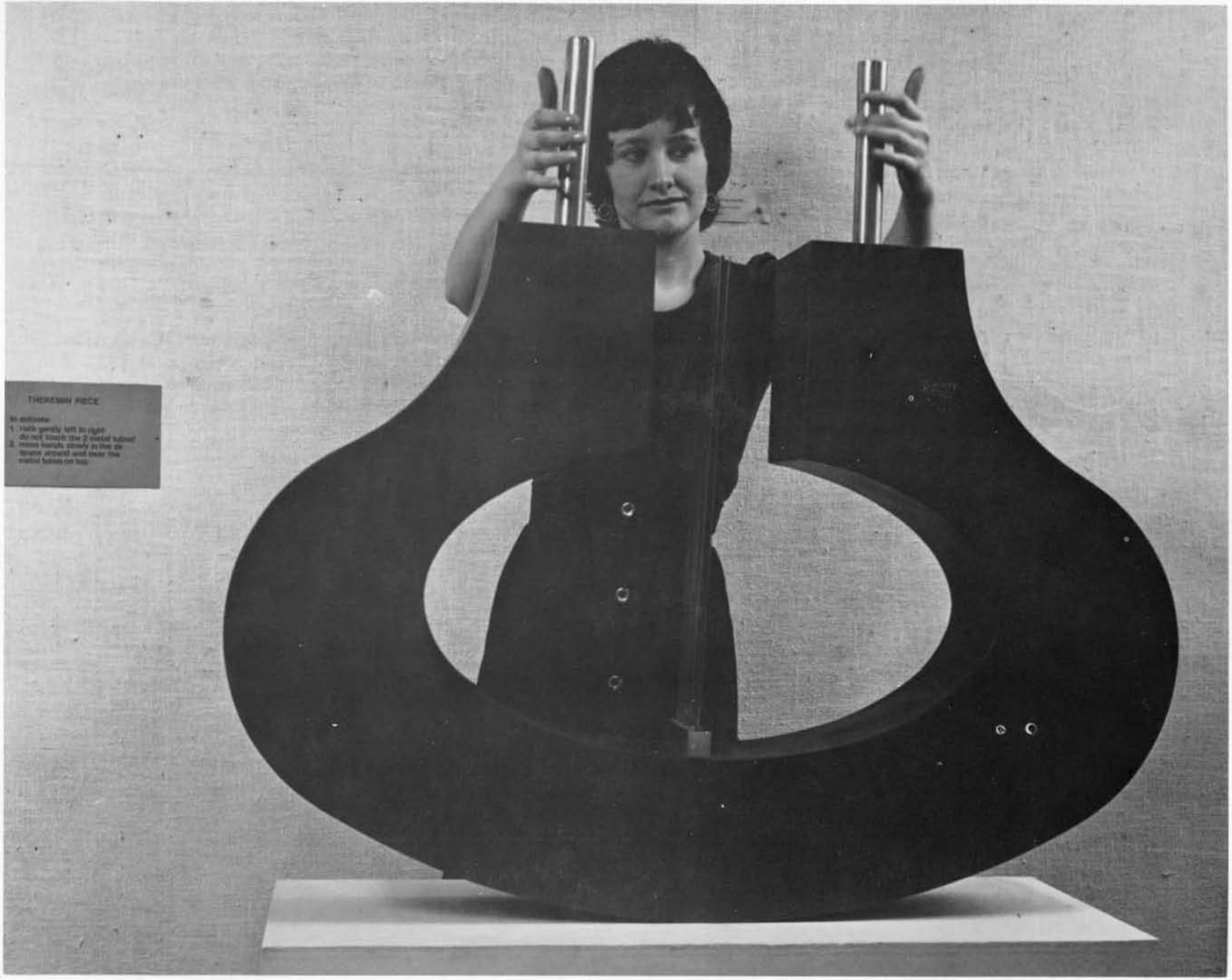


Figure 2

Blue Seven
painted fibreglass (motorized)
22x31x14 inches



The Fuzz is Your Friend
monkey fur, painted wood, fibre-glass (motorized)
48x48x50 inches



Theremin Piece
birch plywood, covered with fibre- glass, metal *36x36x8 inches*

Another of this group is a piece called 'The Fuzz is Your Friend', built in 1967. A large ball covered with black monkey fur is suspended in space on a hexagonal table by three springs. The table is 39 in. high and the ball 24 in. in diameter. The ball has a motor and eccentric inside and gets current through two of the springs. When a foot switch is stepped on, the ball begins to jump up and down rather sluggishly. The moving fur has erotic overtones. People usually react strongly to the piece; some are frightened whereas some seem to enjoy touching it(cf. page 84).

Mathematical configurations have been the stimulus for the shape and movement of many of my recent pieces particularly the pieces that incorporate sound. Franz Reuleux, a nineteenth-century mathematician wrote on the subject of man and machines in three-dimensional space, and discovered the particular set of geometric figures that are constant diameter shapes[5] (cf. Fig. 2). They can be drawn from any regular or irregular odd-sided polygon and they move in a non-circular curve of constant diameter enabling them to rotate, oscillate or turn over on themselves while maintaining their balance.

'Theremin' is an electronic instrument that changes tone and volume by body capacitance. Moving your hand near the right-hand chrome tube on top of the piece, the tone (or pitch) becomes higher, and moving the other hand near the left-hand tube changes the volume. Thus, the viewer produces electronic music. The center rods play sounds when the piece is rocked and can be used alone or in conjunction with the theremin(cf. page 85).

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2. E. Mundt, Review, 'Artforum', 2, *32* (April 1963).
3. C. Mattox, 'Sculpture in the Sixties', statement in exhibition catalogue (Los Angeles: Los Angeles County Museum, 1969.)
4. C. Mattox, Notes on New Works, 'Artforum' 4, *62* (Feb. 1966).
5. J. Langsner, Kinetics in Los Angeles, 'Art in America' 55,*108* (1968).

PART II

A Note

This section presents material from four distinguished senior artists who hail from very diverse, multi-disciplinary backgrounds.

The contributions by Harry Partch and Lou Harrison cover over-all views and attitudes important to the life stance of both the sound sculptor and the artist at large. Gyorgy Kepes outlines the history of one of the most important facets involved in the creation of sound sculpture: the laws of proportion. R. Murray Schafer explores the avenues of metamorphosis between the acoustic and visual event, from its beginnings in classical music to the present as a multi-artform.

Harry Partch, conceived in China, was born in California in 1901 and died there in 1974. Partch once whimsically cited as basic influences on his creative output: "public libraries, Yaqui Indians, Chinese lullabies, Hebrew chants for the dead, Christian hymns, Congo puberty rites, Chinese music halls in San Francisco, lumber yards, junk shops, and 'Boris Godunov'.

Harry Partch with his 'Gourd Tree' and 'Cone Gongs'.

HARRY PARTCH

Harry Partch is the man who first used the combined three phrases: magical sounds; visual form and beauty; and experienced ritual, as describing the core genesis of his art.

Here is an essay, long out of print, which Partch wrote in 1952, preceded by a brief excerpt from a dissertation made on audio tape by Partch in 1967 on 'Monophonic Just Intonation.'

His action, wisdom and work during the past fifty years has continued to influence the work of artists of every generation the world over. He is viewed by many of these artists as the founding father of Sound/Sculpture, among other things.

"Meaningfulness must have roots. It is not enough to feel that one's roots extend back only a decade or a century. It is my strong belief that the human race has known and abandoned magical sounds, visual beauty, and experience-ritual more meaningful than those now current. I must therefore decline to limit the dimensions of my rather intense beliefs by the modernly specialized word: music. I believe devoutly that this speciality must become less specialized for the sake of its own survival.

"The experiential, ritualistic, dramatic area has constituted a very large part of my belief and work. And as for imaginative and sculptural forms of instruments I have easily given as much time to this endeavour as to intonation . . . .

" . . . . It is either very easy or very difficult to recline alongside dogma with serenity. I have seen through most of my life how lonely and contemplative investigation of musical, human materials is discouraged by dogma. The doors that are closed *because* of education are the saddest doors that humanity never walked through. And there is at least the question whether the world has already known and long ago abandoned both habits of education and usages superior to those we currently adhere to.

"Now that we have suffered the present dogmas in the West for about 300 years, who would want to exchange them for a different set of rigid stipulations? I wouldn't. Responsible freedom, it seems to me, is the dissideratum.

"The widely revered master-disciple concept represents, on both sides, too easy an escape into the limbo of no responsibility. I have said that if anyone calls himself a pupil of mine, I will happily strangle him. But this is simply an expression of an attitude, and amazingly, in the deeper meaning, it is an expression of hope."

No Barriers

Once in a while it would seem desirable, between all the specialized stimuli – of music in concerts, of the verbal in plays, of the dynamically visual in ballet – to find all these apparent desires and responses in a single work of art. A work that would not exclude any area of response – visual, aural, verbal – in any combination, in order to engage the whole person, either as performer or as observer. Experience does not exclude, because the eye, the ear, the body, and the mind register, react, store away, and therefore evolve, consciously or otherwise. The mind does not put its reactions into little locked rooms to be opened laboriously, one at a time. Under appropriate stimulus they unlock without conscious effort, instantly and simultaneously.

If understanding is a valuable personal asset it is desirable for each participant in such a work to be aware of the total potential of any human involvement. The musician as dancer, the dancer as ditch-digger, the ditch-digger as physicist, the physicist as hobo, the hobo as messiah, the messiah as criminal, or any other conceivable metamorphosis. Perhaps such a statement seems irrelevant to the idea of a work of art, yet I do not think so.

Without understanding of human experience there is nothing. No interpretation, therefore no communication. No at-oneness, therefore no universality. We may work, as artists and creators, toward originality and individuality. Yet we must know that this is not a goal, that it must simply be inevitable and incidental, because – in a true biologic sense – each of us is an original and individual being. Death alone, however we may interpret it, is evidence enough. For an artist to be different, with forethought, is to be as my playwright friend Wilford Leach has written, "just plain perverse (which is often the case), dealing in nonsense (which is often the case), either playing a big joke on his audiences or an even bigger joke on himself (which is generally the case)."

The inspiring-exasperating and life-giving life-destroying purpose of the creative artist or interpreter is the attainment of understanding that sires communication. Discovered books may help, and frequently do: teachers also, though seldom; the room crackling with witty conversation – however enjoyable – almost never. Experience, experience, experience, and after that some lonely walks along the railroad tracks or a thousand other places, to make experience meaningful – these are all-imparting.

Some philosophy, however personal, however put down, must – in my humble opinion – validate any statement regarding the actual mechanics of communication from the stage or any place else but, here again one can only point. The creator clears as he goes, he evolves his own techniques, devises his own tools, destroys where he must. If he wants a whole-experience reaction from his audience he employs or stipulates every possible stimulus at his command, singly or simultaneously; including music of any imaginable bastardy; dance and drama in any historical or anti-historical form, noise, light, shadow, substance, or perhaps only the semblance of substance, and sounds from the mouth that communicate only as emotion.

The audience need not worry him too much. The separate ways in which people have been conditioned, with one attitude at a symphony, another at a play, still others – separate and distinct – at night clubs and hash houses with juke boxes, jam sessions, and community sings, are only skin deep. Touch the total experience, which does have an underlying total affinity and the conditioned attitude evaporates, though perhaps only for a moment.

That there is, in total experience, a deep and abiding tie with peoples removed both in time and space, seems to me beyond argument. In this regard music alone, of the elements that we ordinarily call culture, has all but been ignored by the Western world. Consider the ancient cultures of the Orient, where the synthesis mentioned is more or less constant practice. We specialize here, too; we study, separately, Oriental languages, literature, art, even dance. We call in lecturers and teachers native to these subjects. Do we have them in music? We do not. We confine our instruments and our repertoire to a few hundred years of Western Europe, and when we do have an Oriental instrument it becomes an idly twanged 'object of art,' or when we are intrigued by an Oriental melody we bring it home to crucify it: "for violin and piano."

This is a small example, and says nothing of our European-conceived instruments, which we largely ignore. It becomes particularly evident when we peruse any student recital program – Suite for Violin and Piano, Sonata for Piano, Variations for Violin and Piano, Etude for Two Pianos – that there is a wealth of instruments of which Audiences, teachers and students are largely unaware.

To a disinterested observer we must seem to be on a conducted tour of a one way street, anxiously picking up academic credits on the way, and coming finally to the end, signed DEGREE, after which there are only two choices (because the idea of imagination has already been pretty well squelched!); conduct others over the same route, or (God forbid!) stop.

I think of the little Negro boys of New Orleans street corners (their "instruments" might be frowned on by our serious musicians), who play washboards, tubs, tincans, anything that intrigues their aural imaginations, and who dance and make sounds from their mouths and grimacing wrinkles on their faces. I feel we cannot ignore this basic impulse.

LOU HARRISON

The following are excerpts from a booklet by the noted composer, poet and painter Lou Harrison, which contains a diversity of useful information. The booklet itself is hand calligraphed throughout. Here are five brief items exerpted from it which serve to complement William Colvig's essay on page 163.

Excerpts from Lou Harrison's Music Primer'*

JUST INTONATION IS THE BEST INTONATION

The ratios 1:1, 2:1, 3:2, 4:3, 5:4, 6:5 and on to infinity are analogs of actual events, i.e., A, 440 v.p.s. is to A, 220 v.p.s. (an "octave") as 2 is to 1; therefore 2:1 correctly represents an "octave," 3:2 corectly represents a trued "fifth," 5:4 a trued "major third," etc. To learn to tune and recognize intervals you had best go to a country, quiet place for a while. When your ears have recovered their powers and are usable again, begin to tune the simplest ratios on some suitable instrument. Gradually add the higher intervals to your knowledge, and various inversions as these may appear in modes or other formations. Each new prime number is a new adventure. I myself would like to be able to command all intervals through prime 13, but at present have only mastered those through prime 7. Beautiful modes are available from the ancient world, too, which one may tune up exactly as they sounded before. I learned most of this from Harry Partch. His book "Genesis of a Music" is immensely informative. The poet Herrick has said, "so melt me with thy sweet numbers." These are the numbers.

FROM THE LATIN, "SURD" = "DEAF"

In modern mathematics the term Surd refers to a ratio in which the terms will not "come out" even:

$$\frac{3.999 \text{ etc.}}{3}$$

The intervals of equal temperament are Surds. Our word "absurd" carries the suggestion "from deafness."

* (C.F. Peter's Edition, New York)

SIMULTANEOUS VARIATION

Simultaneous variation is, by far, the worldwide serious form of ensemble music. This is basically Octaval counterpoint. In Iran it takes the form of a very tight canon (generally at one pulse distance) and is intensely ornamented. Such a style also occurs in India. In Japan a kind of Rubato Canon is charming, in which one voice may be momentarily either ahead or behind the original – the rhythm is not exactly imitated. In non-canonic form, East Asian orchestral music is very rich in Simultaneous Variation. The "old style" gamelan music of Java and Bali, the orchestral works of China, Korea, Japan, and others, are entirely fascinating and alluring in the invention and expression of their various parts, and too, in the power of their general sound. This is a beautiful kind of music. (I refer of course to the ethnic musics, and not to the presently popular International Gothic idiom which is "western" in origin.)

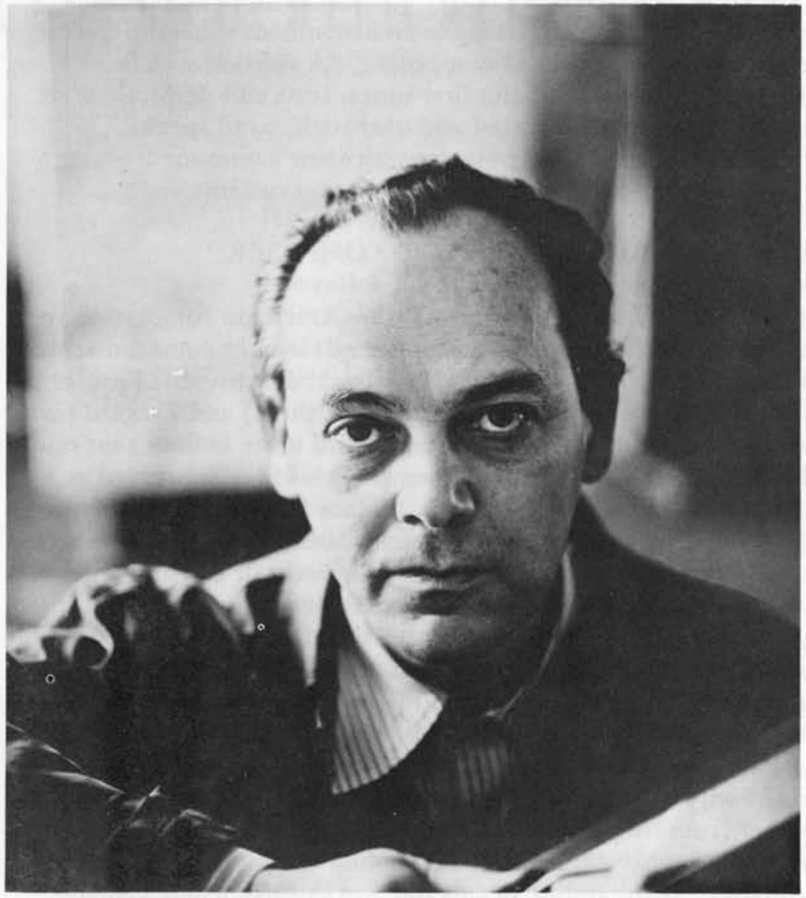
MAKING AN INSTRUMENT

Making an instrument is one of music's greatest joys. Indeed, to make an instrument is in some strong sense to summon the future. It is, as Robert Duncan has said of composing, "A volition. To seize from the air its forms." Almost no pleasure is to be compared with the first tones, tests and perfections of an instrument one has just made. Nor are all instruments invented and over with, so to speak. The world is rich with models – but innumerable forms, tones and powers await their summons from the mind and hand. Make an instrument – you will learn more in this way than you can imagine.

THREE TROUBLED ATTEMPTS TO EXPLAIN ABOUT MONEY AND COMPOSER

Three troubled attempts to explain about Money and Composer. 1) As one American foundation report expressed the matter, the composer himself subsidizes the art of music. It is only common sense then for the composer to find out for himself exactly how much he can afford. For myself, I prefer to own most of the instruments for which I write (and to be able to play most of them) and I regard owning a press or a blueprinting apparatus as essential; preferably both. I more and more believe that one's private support and activity should be the real aspect and limits of a composer's life – conceived as a compound of Harry Partch and Arnold Dolmetsch perhaps, along with William Blake and possibly William Morris (if one has a little money of his own). The path to silliness nowadays is to allow one's self to become indebted to a silly society – do not do it. Find out what you yourself can and will afford – do only that. 2) If you really have to be a composer and are attractive and uninhibited, then try to get yourself "kept" – whether by woman or man. This might be easier than undertaking a whole second career in order to be able to afford composing, and you might get a little restorative affection as well. 3) The Public is something of a Monster. By duly constituted laws it appropriates a composers works – all of which it claims for "Public Domain." It loans to the creator of this wealth, for a brief period, a few little rights over his works. By copyrighting his work the composer accedes to the presumptive arrangement. (Is this somewhat of why Charles Ives refused to copyright his?) We must then get our life means by other methods – either from by-products like teaching, copying, arranging, etc., – or by completely other means. Here the public is only parasitic in demanding taxes – it does not take the entire thing as it does in the primary matter. If the public deems our works sufficiently valuable to go to the trouble to claim them by laws, then why does it not "Keep" us, or recompense us in the manner indicated?? Instead it seems to fancy that our greatest desire, even Need, is to Please it!

GYORGY KEPES



Gyorgy Kepes

Born 1906 in Selyp, Hungary. 1930-36 worked in Berlin and London on film, stage, and exhibition design. In 1937 came to the United States to head the Light and Color Department Institute of Design, Chicago. Since 1946 Professor of Visual Design, M.I.T. Presently director of M.I.T.'s Center for Advanced Visual Studies. Works are in the collections of many major American museums.

Of M.I.T.'s Center for Advanced Visual Studies, Kepes has said: "It is a research center, or more correctly a 'search' center, for new creative objectives, new formats in art. The aims of the Center are threefold. First, to investigate the possibilities of creative work on a civic scale that could give new artistic dimensions to our urban environment, and thus revitalize civic awareness to environmental values. Second, to develop participatory artforms; spectacles, events and pageantry that might bring a new sense of community to isolated individual lives. Third, to learn to utilize new techniques of communications media to develop our sensibilities as well as our consciousness of our present ecological and social situation."

Kepes discovered a description of gas flames modulated by music in an 18th century book on opera. For several years he worked toward the development of a work of art based on this principle. Paul Earls composed the music for this piece, "Flame Orchard." For further comment, see the section on Earls.

From the New Landscape in Art & Science

The poetic imagination of the ancients sought harmony in opposites, anticipating some of the advanced scientific thought of our time . . . how well they worked depended upon a ratio. Pythagoras, like Heraclitus, felt a hidden measure in the fluctuation of opposites, a measure which underlay the Cosmos, as he named the well-ordered universe. This measure was a numerical proportion, a mystic key to all harmonies.

To the Pythagoreans the whole heaven was a numerical scale. The decimal ratio they discovered in the intervals between the known planets was used for the intervals of the Greek musical scale, a correspondence inspiring reverence and awe. The analogue established became the springboard for an immense speculative leap: here, they felt, was a revelation of a primordial, predestined bond—"the music of the spheres" – uniting the entire cosmos into a fundamental mathematical order. The number 10, summing up all numbers, was exemplified by the the mystical emblem of the Pythagorean School, the ten-pointed magic pentagram.

To us, the pentagram is the familiar "five-pointed" star formed by the extension of the regular pentagon's sides or by the endless line which joins alternate angles. The pentagon was manipulated in three dimensions to form the twelve-faced dodecahedron, the regular solid of which every face is a pentagon. The four previously discovered regular solids – the four-sided pyramid or tetrahedron, the six-sided cube, the eight-sided octahedron, the twenty-sided icosahedron – were looked upon as exemplifications of the four elements of the physical world, earth, air, fire, water. Now the fifth of the regular solids or "Platonic bodies," the dodecahedron, became the exemplification of the universe itself. If the dodecahedron was the universe, the pentagon was its basic unit.

In the geometry of the pentagon, the line segments of inscribed and circumscribed pentagrams and pentagons, progressing from smaller to larger, form a mathematical series related to the Fibonacci series. In any two successive terms of this series, the ratio between the sum of the two and the larger term is identical with the ratio between the larger term and the smaller. Articulated into triangles, rhombi and other shapes, the pentagon produces this same ratio time after time. The ratio is an irrational constant, 0.618 . . ., the divine proportion, as Luca Pacioli called it, or, as his friend Leonardo do Vinci later named it, the "golden section."

The golden section joined the pentagon and dodecahedron as fundamental expressions of a unitary universe, and was equally revered by the Greeks. It was the basic proportion which, echoed and re-echoed from the smallest things to the largest, harmonized all with all. The Greek temple, focal point of the common life of men and the gods, was laid out in accordance with the golden section. Its articulate structure constituted a rhythmic progression of numerical terms, from individual ornamental units through the main divisions of substructure, columns and superstructure to the building as a

whole. The common measure ultimately linked the heavens with man and all his work, together in the universal harmony of the "music of the spheres." The sculptor Polyclitus' statue the 'Doryphoros' was an illustration of his treatise on measure – the proportion of finger to hand, hand to arm, arm to the body masses, and each of these to the statue as a whole, created at every step a new unity extending, like the Greek temple, to the outermost circle of heaven.

For twenty-five centuries, the decimal magic of the Pythagoreans has fired the imagination of artists and scientists. Poet after poet has found inspiration in the concept of the music of the spheres. The medieval concepts of macrocosm-microcosm and of the hierarchy of spiritual levels from God to brute with man – "neither beast nor angel" – at the centre, stemmed from the Pythagorean roots of Neo-platonism, which had passed into Christian thought through the work of St. Augustine. It was with the magic pentagram that Faust foiled Mephistopheles. Kepler inscribed and circumscribed the five Platonic bodies with the spheres of the planets to create his model of the great plan of the universe. Artist after artist – Vitruvius, Gothic master builders, Luca Pacioli, Alberti, Leonardo, Durer, Piero della Francesca, Serlio, Palladio, Vignola – has sought in the golden section not only an infallible key to the creation of beauty but, also, a fundamental expression of nature's universal harmony. "Proportion," Leonardo wrote, "is found not only in numbers and measures, but also in sounds, weights, times and places; and in every line." Even in our day, elaborate structures of esthetic theory based on the golden section have won widespread acceptance.

If, now, we find the golden proportion inadequate as the common denominator of nature's harmony, we may recognize the validity of the process of thought out of which the idea emerged. Inherent in the relation between any two opposing aspects of morphological phenomena there is a third new aspect: "But two things cannot be held together without a bond which most completely fuses into one of the things bound. Proportion is best adapted to such fusion," Plato said in his 'Timaeus.' The basis of proportion varies in accordance with the world-view and the intellectual equipment of each society. It shifts from the whole-number intervals of the Greek musical scale to relations derived from such geometrical figures as regular polygons; the latter include proportions which are incommensurable, and can only be expressed in irrational numbers. The common ratio was sometimes found in the part-whole relations of a static structure, like a temple or column, at other times in the mathematical relations of the dynamics of growth, as in the logarithmic spiral which describes the growth of snail shells. The understanding of proportion was sometimes limited to a narrow aspect. At other times, the following definition by Vitruvius, it could encompass many levels. "Symmetry resides in the correlation by measurement between the various elements of the plan, and between each of those elements and the whole . . . As in the human body . . . it proceeds from proportion which the Greeks called analogia – which achieves consonance between every part and the whole . . . This symmetry is regulated by the modulus, the standard of common measure for the work considered, which the Greeks called 'The Number' . . . When every important part of the building is thus conveniently set in proportion by the right correlation between heights and width, between width and depth, and when all these parts have also their place in the total symmetry of the building, we obtain eurythmy." *

*Vitruvius, 'Book I,' Chapter 1, 4.2

Flame Orchard by Gyorgy Kepes
with Mauricio Bueno, Dr. Walton,
music by Paul Earls

aluminum, copper, propane,
transducers, audio equipment

R. MURRAY SCHAFER

Born 1933 in Sarnia, Ontario, R. Murray Schafer is an international figure in the performing arts, music education, and acoustic ecology. Currently, he is Director of the World Soundscape Project. His essay, which follows, explores the metamorphosis of the graphic visual event with the acoustic event. The article illustrates yet another necessary dimension through which one can gain further insight into the developing world of sound sculpture.

The Graphics of Musical Thought

During the past decade many composers have begun to experiment with new musical notations, and while many styles exist, all are characterized by a common feature – their greater dependence on graphic elements. I have frequently experimented with graphic notations, and in the course of these experiments it has occurred to me that a new type of artistic experience may be opening up to us, in which musical elements could have revitalized graphic correspondences in such a way that one sensation could be triggered by another to produce synaesthesia – that is, a fusion of two art forms into a unitary experience. Such an experience would no longer merely be reminiscent of metaphor; it would not be a case of one art receiving side-stimulation from a neighbour. The arts illuminate one another by means of metaphor; by means of synaesthesia they disappear into one another.

We are obviously still some distance from this situation. Its achievement rests on a more discriminating understanding of the links between music and graphics, and accordingly the first purpose of this essay is to discuss some of the ways in which graphic considerations have influenced the style of Western music to date. At the close I will try to illustrate some possible future directions.

THE CONDITION OF MUSIC

Music exists in time and is aurally perceived. When its time runs out it disappears. Those who made it may remember it and recapture it, or forget it.

The notation of music exists in order that musical thoughts should not be forgotten. Notation describes aural sensations by means of a nomenclature which is written out in two-dimensional space (the musical score).

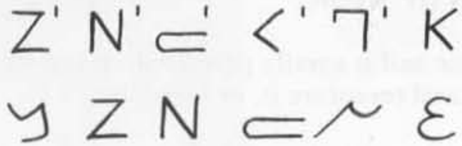
Thus, to preserve musical ideas, they must pass out of time, through a spacial screen (notation) and back into time (performance).

All musical cultures have not developed notation; some have none; others have systems which are only rudimentary. When a society undergoes little or no social change, relative stability of the musical repertoire can be assured by means of the memory alone. The West has produced the most elaborate system of musical notation because it has been the most dynamic culture. In a changeful society oral traditions cannot survive long and if the music of the past is to be preserved at all, some method must be devised by which it may be stored and later retrieved. This has been achieved up to the twentieth century by a progressive refinement of musical notation. It is noteworthy that while the West is now challenging conventional notation, Eastern scholars are frantically trying to devise means to write down their classical music, which, I take it, prefigures a dynamism in the East as well as perhaps a relaxation of the dynamic thrusts of the West.

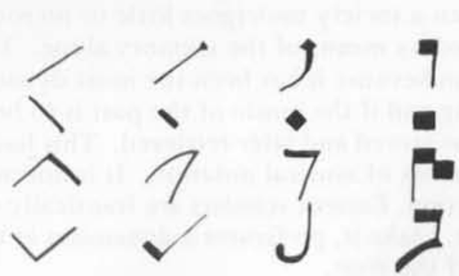
A development which has influenced Western music profoundly in recent times is the invention of disc and tape recording. In a way these techniques permit a more definite record of the composer's intentions than the written score could ever provide. Recording has affected the structure as well as the notation of music. For one thing, it removed the need for recapitulation in composition. It is no accident that Schoenberg and his followers developed a musical language which was athematic (i.e., without repetitions and recapitulation) about 1910 at the same time as recording became commercially successful. From then on, the recapitulation was on the disc. But a discussion of this subject would lead us away from our theme.

SHAPES AND SYMBOLS FOR THE TIME-STREAM OF MUSICAL THOUGHT

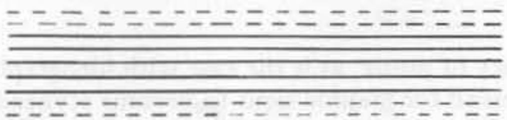
Any musical notation will contain both graphic and symbolic elements. The first notations developed were predominantly symbolic. A cuneiform script from Babylon, believed to be musical notation, is indecipherable because its characters appear to be symbols for note-clusters or motives rather than single notes. In the musical notation of the ancient Greeks, letters of the alphabet stood for notes of the scale. Nothing was indicated about the rhythms of music or its flow through time except to identify it loosely with the horizontal displacement of the letters from left to right as in writing – a convention which has remained to modern times.



The Christian era added the convention of identifying pitch with the vertical dimension. To record the melodies of Gregorian chant, the Church borrowed the diacritical accents employed in rhetoric and these gradually evolved into a system of 'neumes,' or signs indicating distinctive melodic curves. At first they indicated merely a rising or falling of the voice, and as such were employed to refresh the memory, for the melodies they signified were already familiar. They carried no particular rhythmic or durational values; these were supplied by the words chanted.



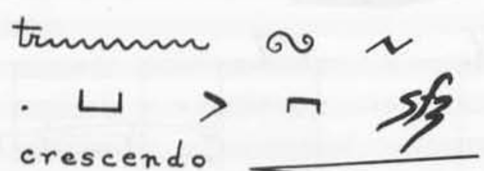
The introduction of the stave gave these signs fixed positions, with the higher notes placed on the upper lines and spaces and the lower notes on the lower lines and spaces. Staves of various numbers of lines were employed before the five-line stave or pentagram became, for purely optical reasons, standard.



The signs for notes developed further and became symbolic with respect to their durations. This was accomplished by the addition of stems and tails and by filling in or emptying the space of the note-head itself.

Unlike the qualitative durational values of early neumatic notation, the values of the modern system are quantitative and proportionate to one another. Mensural notation is the term given to this method of writing, where the whole note has a fixed value equal to two half notes, four quarter notes, eight eighth notes, etc. Since more space is required to write a rhythmically complicated passage than one consisting of whole notes, the graphic analogue between time and horizontal extension falls down with the symbolism of mensuration; but the eventual introduction of barlines, originally at uniform distances in the score, restored this convention temporarily. An inspection of printed music today will show, however, that barlines are usually not placed at uniform distances but vary according to the amount of activity in the bar.

Signs for embellishments such as the turn, trill and mordent have both graphic and symbolic associations. The turn rotates on its axis, the trill suggests nervousness, while the mordent snaps at its neighbours. The dot used for staccato obviously suggests an abbreviated life; but the signs for accents and bow markings appear more symbolic. A few other editorial signs such as 'sfz' (with sudden force) may appear slightly graphic in as much as they are printed in bold italics in the score, but other impressions, 'pianissimo,' 'mezzo forte,' etc., are purely symbolic. It is interesting that modern notation has preserved both the symbolic words 'crescendo' and 'diminuendo' and their equivalent signs suggesting growth and decay.

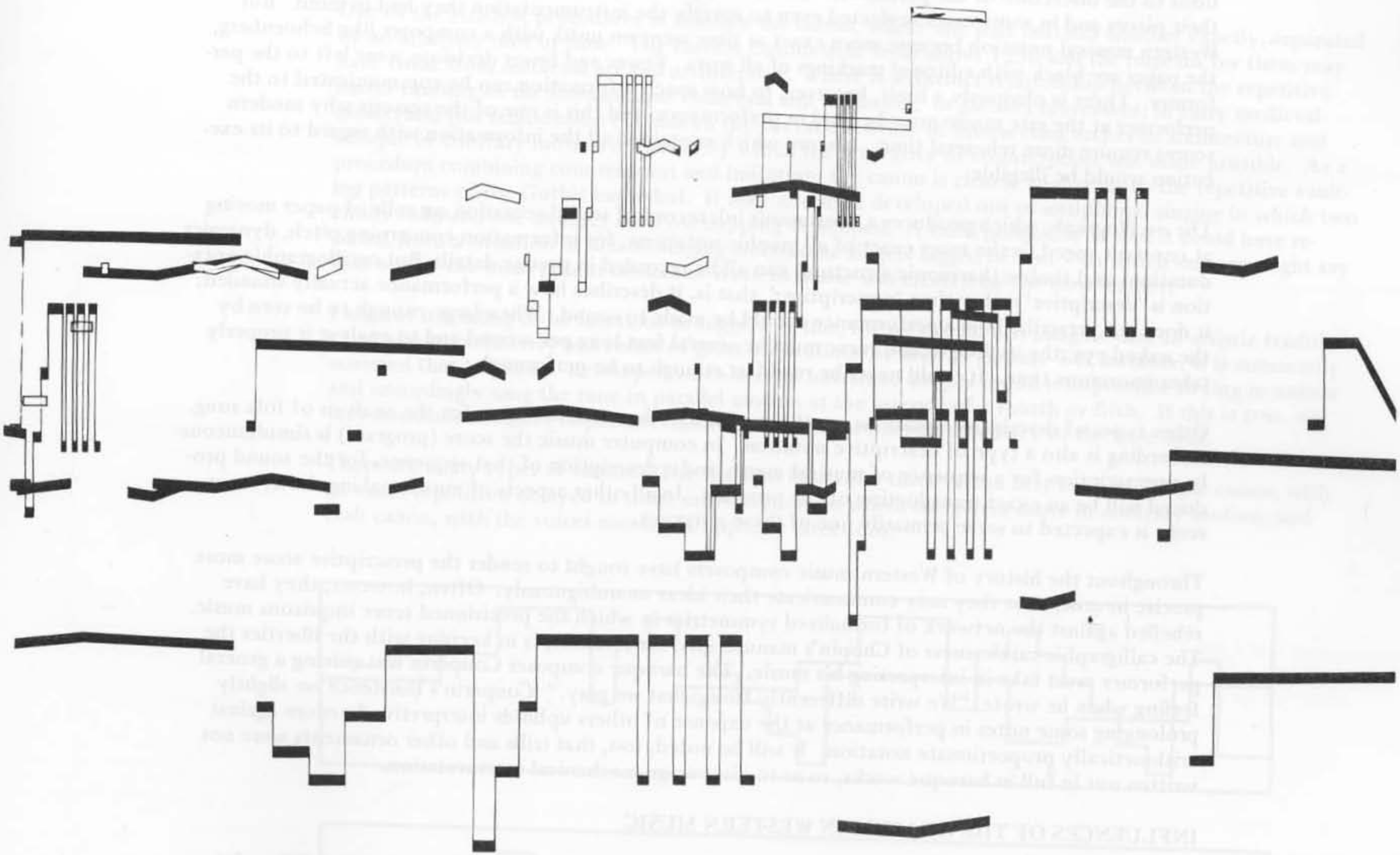


Tempo markings may also be called symbolic for they indicate the speed with which one is to read across the page. One does not read music at a tempo of convenience such as a poem, but at an arbitrarily prescribed rate, and this varies according to the editorial instructions: 'ritardando,' 'accelerando,' 'tempo rubato,' etc.

Throughout the history of music, as is the case with ideographic writing systems of all kinds, a general tendency can be observed for graphic signs to become stylized and ultimately symbolic. In general we may say that while conventional notation preserves both symbolic and graphic elements, the former tend to be more organized and therefore predominate.

Symbolic signs form a code of mnemonic aids. They must be learned in advance, but once learned they are capable of rendering a good deal of precise information in a highly compact space. We may call symbolic notation static and graphic notation dynamic, by which we mean that symbolic notation tells us a great deal about specific musical thoughts but little about how these thoughts are linked together, whereas graphic notation tells us less about specific thoughts but more about their general relationships and formal shapes.

This can be illustrated. A page from the author's "Untitled Composition for Orchestra" in its original notation is followed by a graphicalized version in which frequency is projected on the abscissa and time on the ordinate, with instrumentation (timbre) differentiated by colour. (Unfortunately our reproduction is in black and white only.) The original notation gives more detailed information as to how the work should be executed, but in the second, the overall shape of the passage becomes immediately apparent and we are able to see that the composition is constructed in the form of a series of canons (or imitations) of varying durations.



PRESCRIPTIVE AND DESCRIPTIVE NOTATIONS

All notations, intended to facilitate the reconstruction of musical thoughts, tend to leave certain questions to the discretion of the performer. Thus, baroque composers rarely indicated the dynamics of their pieces and in some cases neglected even to specify the instrumentation they had in mind. But Western musical notation became more exact as time went on until, with a composer like Schoenberg, the pages are black with editorial markings of all sorts. Fewer and fewer decisions were left to the performer. There is obviously a limit, however, to how much information can be communicated to the performer at the rate music must be read in performance, and this is one of the reasons why modern scores require more rehearsal time. A score which contained all the information with regard to its execution would be illegible.

The oscillograph, which produces a continuous ink record of sound sensation on rolls of paper moving at constant speed, is the most exact of all graphic notations, for information concerning pitch, dynamics, durations and timbre (harmonic structure) can all be recorded in precise detail. But oscillographic notation is 'descriptive' rather than 'prescriptive;' that is, it describes how a performance actually sounded; it does not prescribe how a performance should be made to sound. When large enough to be seen by the naked eye, the oscillographic curve must be several feet long per second and to analyse it properly takes enormous time. It could never be read fast enough to be performed.

Other types of descriptive notations are those used by ethno-musicologists for the analysis of folk song. Recording is also a type of descriptive notation. In computer music the score (program) is simultaneously a prescription for a sequence of musical events and a description of that sequence, for the sound produced will be an exact transduction of the program. In all other aspects of music making, however, a score is expected to serve primarily one of these purposes.

Throughout the history of Western music composers have sought to render the prescriptive score more precise in order that they may communicate their ideas unambiguously. Often, however, they have rebelled against the network of formalized symmetries in which the precisioned score imprisons music. The calligraphic carelessness of Chopin's manuscripts, for instance, is in keeping with the liberties the performer must take in interpreting his music. The baroque composer Couperin was voicing a general feeling when he wrote, "We write differently from what we play." Couperin's insistence on slightly prolonging some notes in performance at the expense of others upholds interpretive freedom against arithmetically proportionate notation. It will be noted, too, that trills and other ornaments were not written out in full in baroque works, so as to discourage mechanical interpretation.

INFLUENCES OF THE GRAPHIC IN WESTERN MUSIC

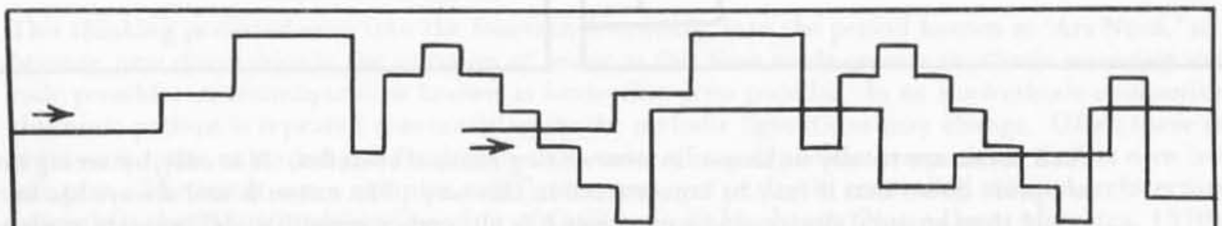
Whether or not a composer thinks in terms of exactly measurable and proportionate quantities of time or in pitches that are discrete and unitary, conventional notation promotes this concept of music making. The metronome was invented to police mensuration, just as the pitch-pipe polices equal temperament. Although I have never seen it mentioned, it seems logical that the principles of equal temperament, transposition and modulation may have been stimulated by the notation employed in Western music, for such a notation encourages uniformity and the transposability of material from one line or space on the stave to any other.

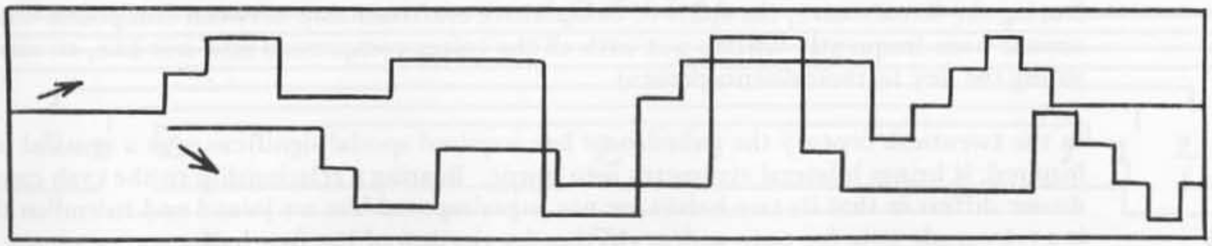
However, it is in the development of form and procedures used in Western music that the graphic influence is most conspicuous. Without written notation some of these forms and procedures would have been impossible, or at best would have remained in a state of perpetual incipience.

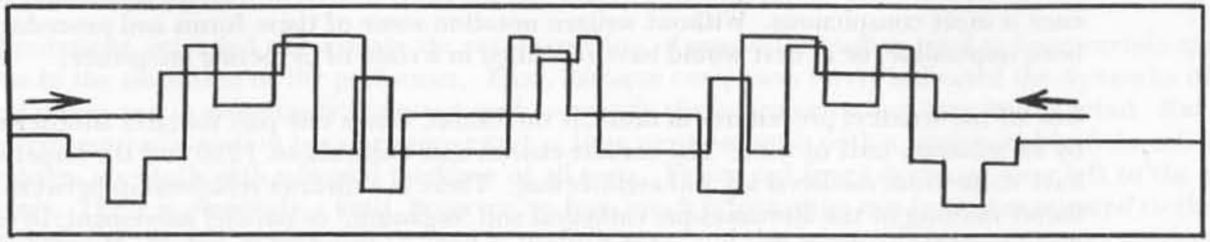
One of the strictest procedures in music is the canon, where one part imitates another exactly, separated by an arbitrary unit of time. The earliest canons date from about 1250 and the impetus for them may have come from medieval art and architecture. There is a distinct relationship between the repetitive barrel vaulting of the Romanesque cathedral and 'organum,' or parallel movement, in early medieval music; and this relationship extends to the coeval discovery of intersecting arches in architecture and oblique or contrary motion in music, by which the tensegrity of counterpoint was made possible. As a procedure combining counterpoint and imitation, the canon is closely analogous to the repetitive vaulting patterns of the Gothic cathedral. It may also have developed out of antiphonal singing in which two choirs followed one another until overlapping developed. A third possibility is that it could have resulted from a situation in unison singing when some singers lagged behind – in which case we might say that one of the most potent devices in Western music was created by the slow learner.

I am not intending to be facetious in suggesting this, for we should not imagine that all artistic traditions came about exclusively as a result of great inspirations by men of genius. For instance, it is commonly assumed that 'organum' developed when certain untrained singers found it impossible to sing in unison and accordingly sang the tune in parallel motion at the interval of a fourth or fifth. If this is true, we may conclude that this important invention was the accidental discovery of the tone deaf.

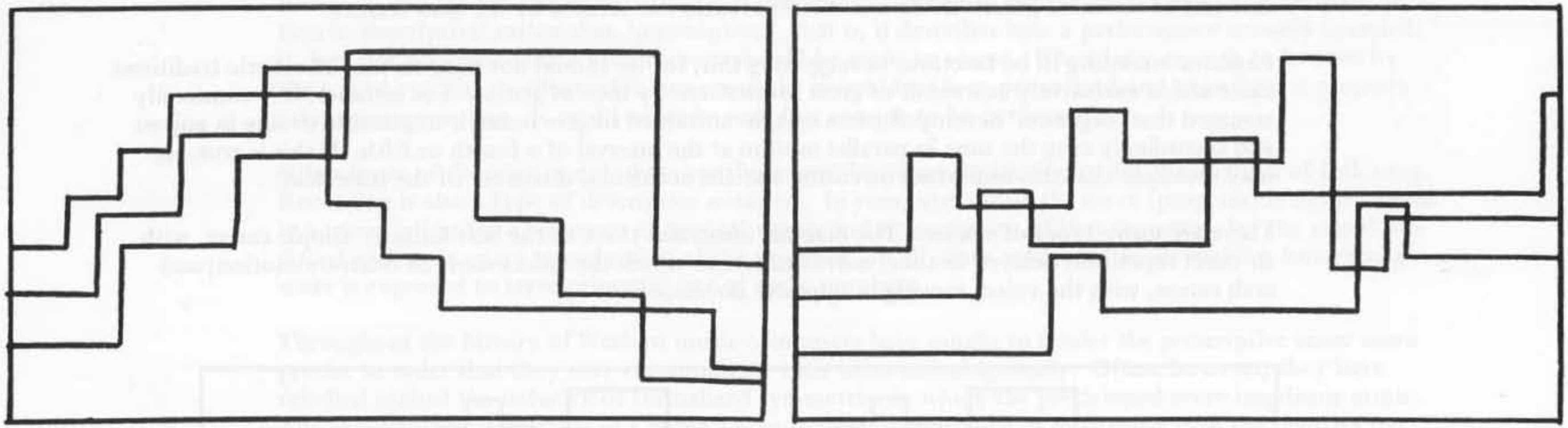
There are many types of canons. The diagram illustrates three of the best known: simple canon, with an exact repetition delayed in time; mirror canon, in which the voices move in contrary motion; and crab canon, with the voices moving in opposite directions.





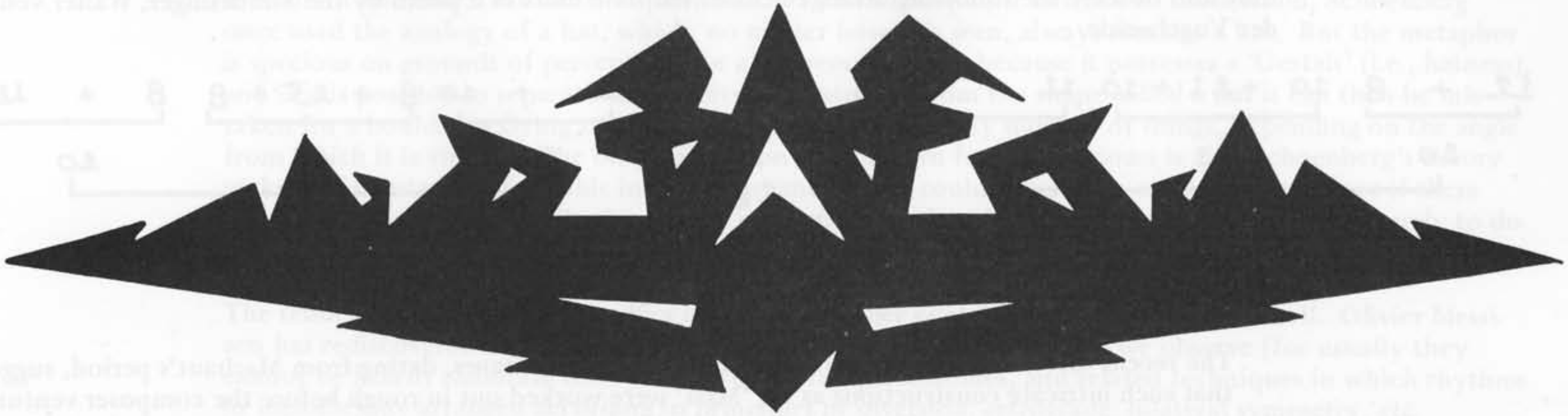


Another type of canon is the so-called prolation canon in which each part proceeds at a different tempo.



Such forms are totally unknown in non-writing musical societies. It is only by seeing music backwards or upside down that it may be constructed in this way. The canon is and always has been a visual rather than an aural device, and sometimes it is altogether inaudible, deliberately made so by composers who regard it as an exercise in craftsmanship – by no means antagonistic to good musicianship. Such is the case with the canons of Bach's "Musical Offering" or with those of certain songs by Anton Webern. During the Renaissance, the spirit of competitive craftsmanship between composers was so strong that canons were frequently written out with all the voices compressed into one line, an acrostic text providing the key to their disentaglement.

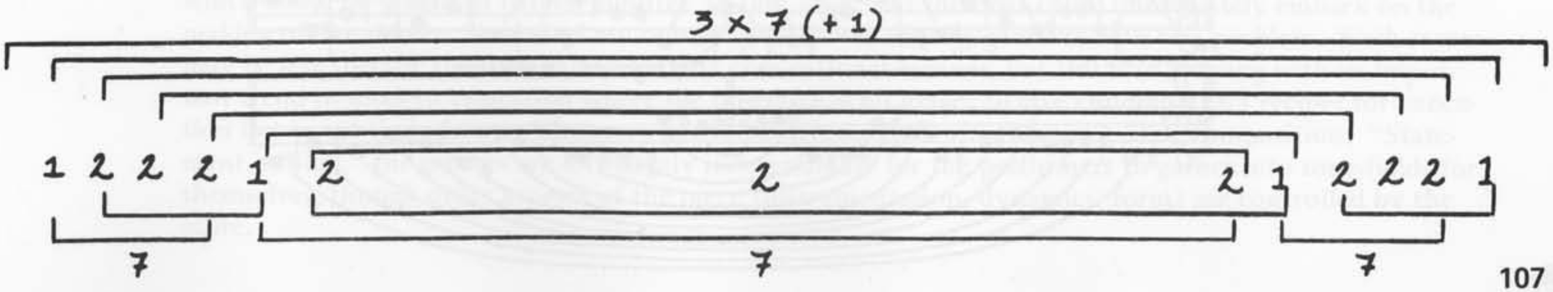
In the twentieth century the palindrome has acquired special significance as a musical form. Visually inspired, it brings bilateral symmetry into music. Bearing a relationship to the crab canon, the palindrome differs in that its two halves are not superimposed but are joined end to end so that the last half is a retrograde note for note and/or rhythm for rhythm of the first half.



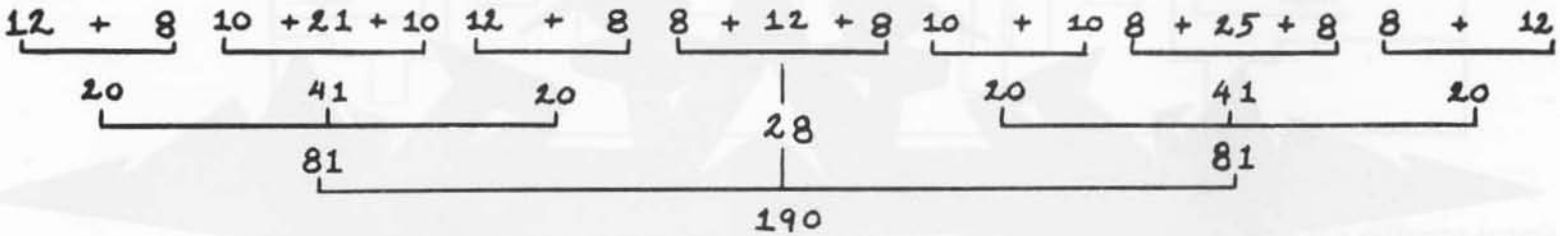
MUSICAL SPACE

Devices such as canons, palindromes and fugues only become possible when a composer is able to project an entire composition in a (meta)physical space which allows the material to be studied from many different viewpoints. This graphic projection of music is evident throughout Western music history. In the Middle Ages, when the melodic and rhythmic features of music were more apt to be considered separately than later, we encounter constructions in which a melodic configuration of a certain number of notes was superimposed on a rhythmic plan of a different length, so that as the two developed together a mathematically-calculable tonal embroidery emerged. By this method a series of, say, four different durations and five different pitches could produce a sequence twenty units long.

This thinking persisted even into the fourteenth century, into the period known as 'Ars Nova,' so called because new discoveries in the notation of music at this time made greater rhythmic nuancing and exactitude possible. A technique now known as isorhythm grew popular. In an isorhythmic composition a rhythmic pattern is repeated constantly while the melodic figurations may change. Often these rhythmic units were quite extended and frequently each voice of a polyphonic composition had its own isorhythmic plan. The result was a complex and flamboyant, yet perfectly controlled musical architecture. The example is the "Christe eleison" section of Guillaume de Machaut's 'Notre Dame Mass' (ca. 1370).

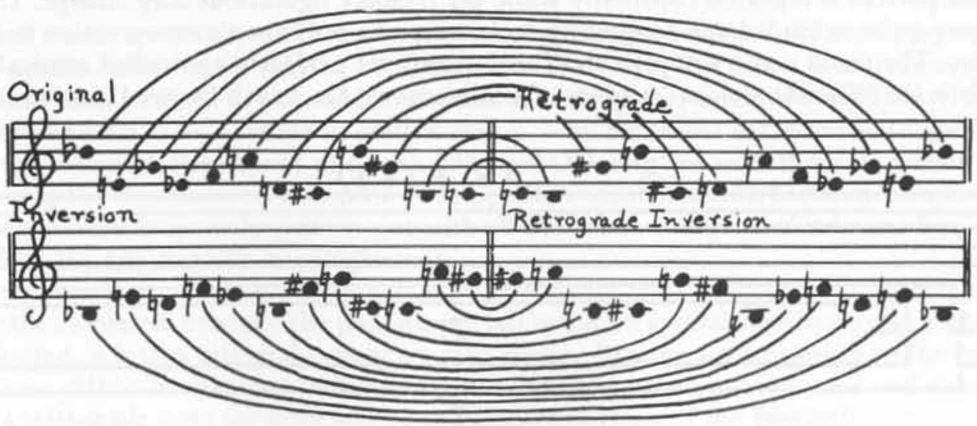


As a demonstration of the ubiquitous interest in formal unity of this kind during the Middle Ages, we may also observe the following arrangement of half-line units in a poem by the Minnesinger, Walter von der Vogelweide.



The recent discovery of a piece of slate containing music staves, dating from Machaut's period, suggests that such intricate constructions as his 'Mass' were worked out in rough before the composer ventured to put pen to paper – and indeed it would be hard to imagine them being otherwise conceived. Such an activity would correspond exactly to the pre-compositional work of the contemporary twelve-tone composer in constructing and checking the possibilities of his tone rows before actually beginning a composition.

In discussing the functioning of the tone row in serial composition, Arnold Schoenberg used the expression "the unity of musical space." Schoenberg, who was also a painter, often remarked that while music was performed in time, the composer composed in space. In twelve-tone music the composer begins by arranging the twelve chromatic notes of the octave into an arbitrary series; this original series is then set down also in three basic transformations: retrograde, mirror inversion and retrograde of the mirror inversion. The original form of the series and its three variants are taken by Schoenberg and his followers as the basic material of a composition: they may be transposed onto any note and may be used in various combinations, both vertically (harmonically) and horizontally (melodically). By referring to this compositional continuum as "the unity of musical space" Schoenberg stressed the versatility of his method, by which the material could be developed in any direction (up, down, backwards, forwards or upside down).



Whether the unity behind these devices can be heard or not is very debatable. Schoenberg's critics said it couldn't and called his work 'Papiermusik.' Drawn into public defence of his method, Schoenberg once used the analogy of a hat, which, no matter how it is seen, always remains a hat. But the metaphor is specious on grounds of perception, for a hat remains a hat because it possesses a 'Gestalt' (i.e., hatness), and if it is possible to separate this quality of "hatness" from the shape called a hat it can then be mistaken for a boulder, a flying saucer, a stove pipe – in fact, any number of things, depending on the angle from which it is viewed. The only conclusion to be drawn for our purposes is that Schoenberg's theory makes deliberate use of graphic inspirations, and in fact could never have come into existence if these had not been employed. Whether or not music thus produced is great or trifling has, as usual, only to do with the talent of the composer, for a system guarantees nothing.

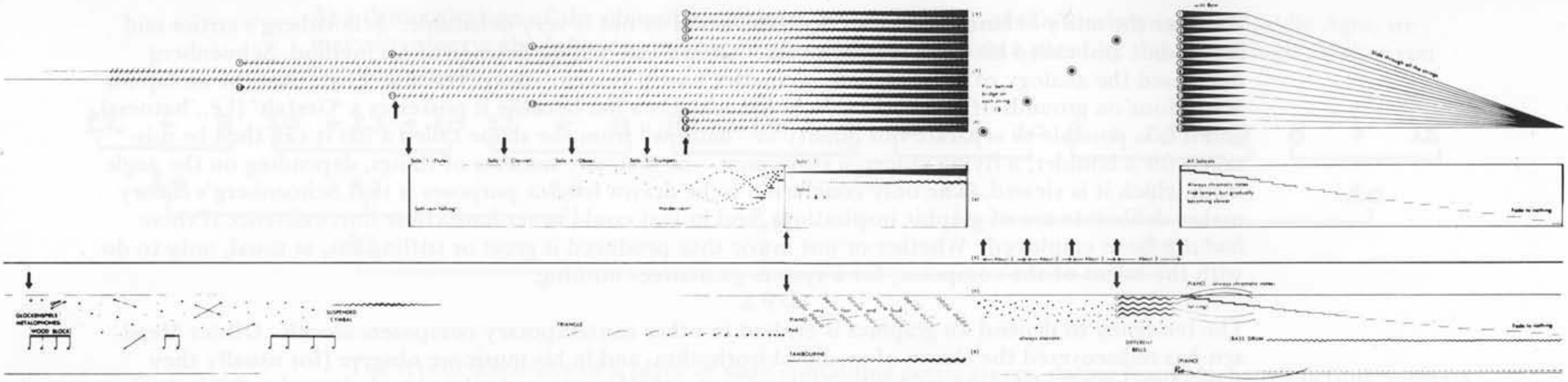
The tendency to depend on graphics is evident in other contemporary composers as well. Olivier Messiaen has rediscovered the charm of medieval isorhythm, and in his music we observe (for usually they cannot be heard) elaborate isorhythmic structures, palindromes, and related techniques in which rhythms or melodies are arranged according to principles of inversion, retrograde, bilateral symmetry, etc.

Even Bartok, while less visual in his whole approach to composition than Schoenberg or Messiaen, speaks of arranging folk songs in such a way that "what we heard in succession we tried to build up in a simultaneous chord" – i.e., the vertical and horizontal dimensions of musical space were interchangeable. In a very real sense, of course, they were always this way for the classical composer, and analysts such as Heinrich Schenker have shown that the melodic structure of Brahms, Schubert or Chopin is frequently an 'Auskomponierung' of harmony. In the same manner, Beethoven once mentioned to a friend that he elaborated a work in his head "in its breadth, its narrowness, its height, its depth . . . from every angle."

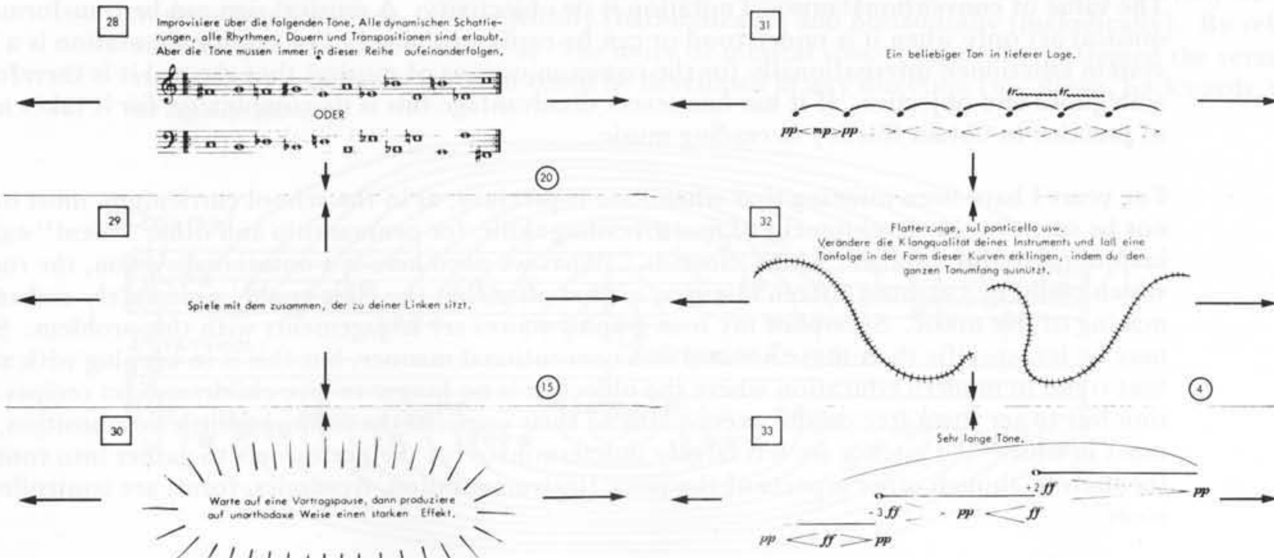
THE TREND FROM EXACTITUDE TO APPROXIMATION

The value of conventional musical notation is its objectivity. A musical sign can be transformed into a musical act only when it is understood or can be easily explained. Conventional notation is a complex system sanctioned internationally for the communications of musical thought and it is therefore unambiguous and objective. If it has one severe disadvantage this is its complexity, for it takes many years of practice to obtain fluency in reading music.

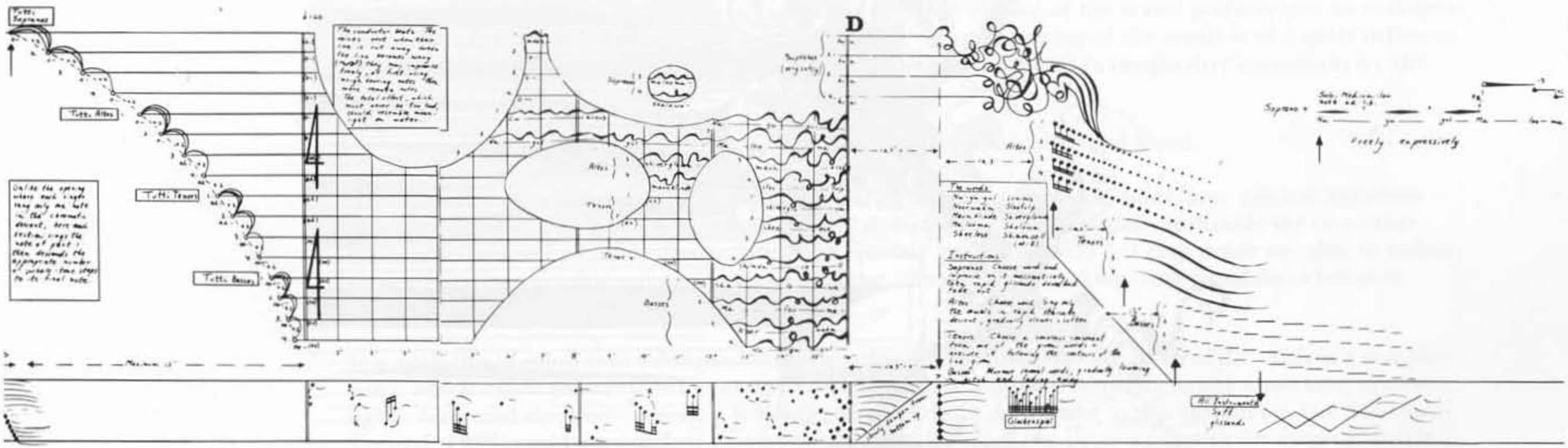
For years I have been insisting that when time is precious, as in the school curriculum, most of it should not be spent in the development of music reading skills, for penmanship and other "silent" exercises are inappropriate for a subject which "sounds." What we need here is a notational system, the rudiments of which could be taught in fifteen minutes, so that after that the class could immediately embark on the making of live music. Several of my own graphic scores are engagements with this problem. Such scores may be less specific than those notated in a conventional manner, but this is in keeping with an important trend in modern education where the objective is no longer to give children exact recipes for execution but to set them free on discovery-paths of their own. In the following little composition, "Statement in Blue," the pitches are left largely indeterminate for the performers to gather into tone-fields for themselves, though other aspects of the piece (instrumentation, dynamics, form) are controlled by the score.



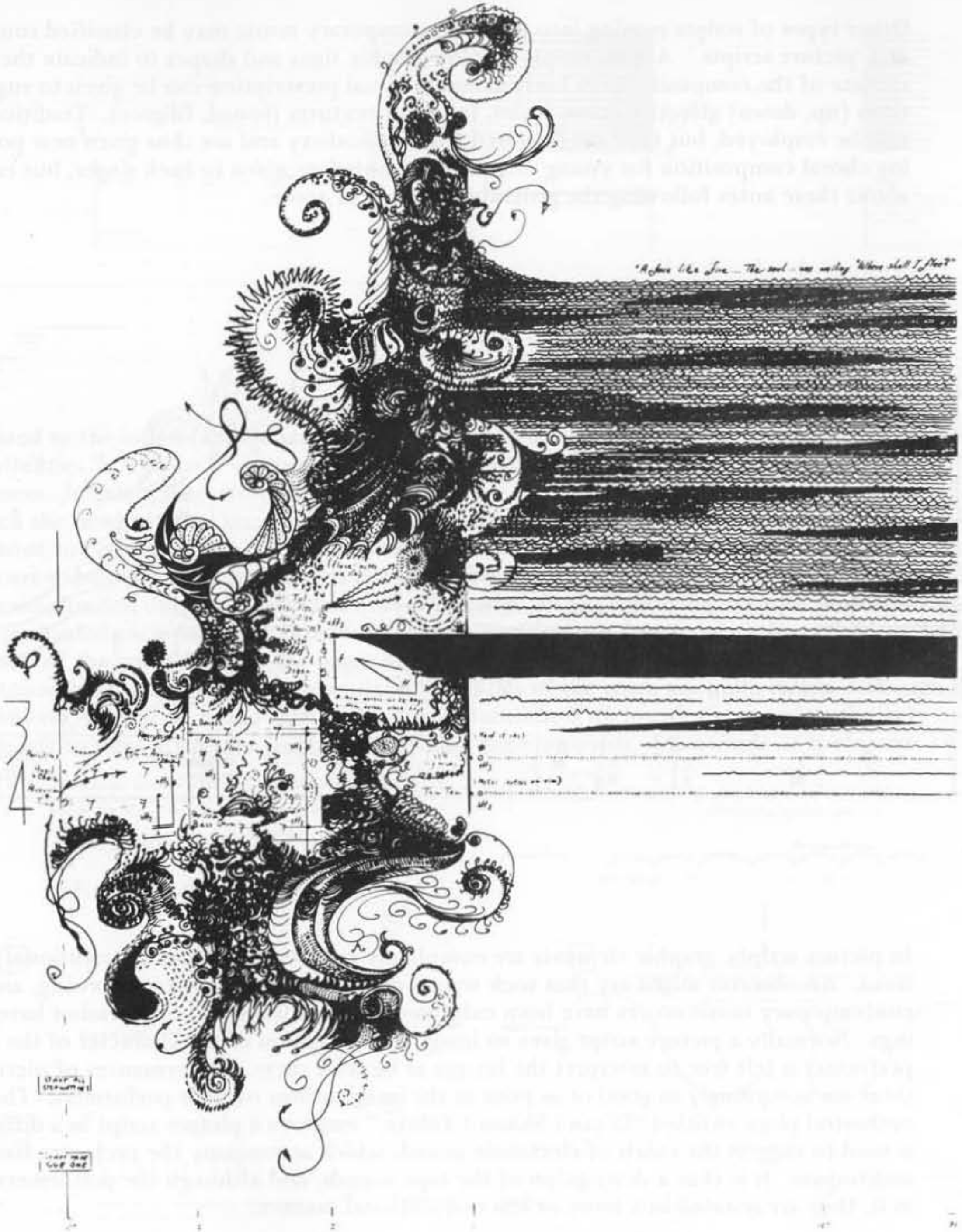
Related to the indeterminate score is one constructed to facilitate what we might call "the form of possibilities." A piece is written in such a manner that it may be organized and reorganized by the performers. In this respect Stockhausen has written: "It is conceivable that scores could be written in which the musical sense was so definitely indicated that the sketch could define all modes of performing without ambiguity." The piece then achieves its ultimate form only when all its possibilities of execution are exhausted. The situation is not dissimilar to that of the mobile which can be viewed in a variety of poses, limited only by its mechanisms of balance. In the following example, entitled "Minimusic," I have divided each page into three fields. Each performer is free to move from field to field by following any of the arrows. Since the pages of the score are cut into three sections, allowing each section to be turned independently, the sequential possibilities of the score are quite varied — though by no means unlimited. (It will be noted that in this score, duration is no longer expressed exclusively by movement from left to right across the page, but may also move upwards, downwards or backwards.)



Other types of scripts coming into use in contemporary music may be classified roughly as 'action scripts' and 'picture scripts.' Action scripts employ graphic signs and shapes to indicate the general emotional climate of the composition. A fairly accurate visual prescription can be given to suggest melodic directions (up, down) affective states (calm, tense) or textures (broad, filigree). Traditional symbols may also be employed, but they are liberated from orthodoxy and are thus given new potency. In the following choral composition for young singers, basic notes are given to each singer, but each is free to oscillate about these notes following the general shapes of the score.



In picture scripts, graphic elements are completely emancipated from all traditional notational conventions. An observer might say that such scripts differ little from abstract drawing, and in fact many contemporary music scores have been exhibited in art galleries and on occasion have been sold as paintings. Normally a picture script gives an image or conception of the character of the music only, and the performer is left free to interpret the images as he feels them. Performances of picture script compositions are accordingly as good or as poor as the imaginations of their performers. The next example, an orchestral piece entitled "Divan i Shams i Tabriz," employs a picture script in a different way. Here it is used to suggest the swirls of electronic sounds which accompany the orchestra from all sides of the auditorium. It is thus a description of the tape sounds, and although the performers' parts are embedded in it, they are notated in a more or less conventional manner.



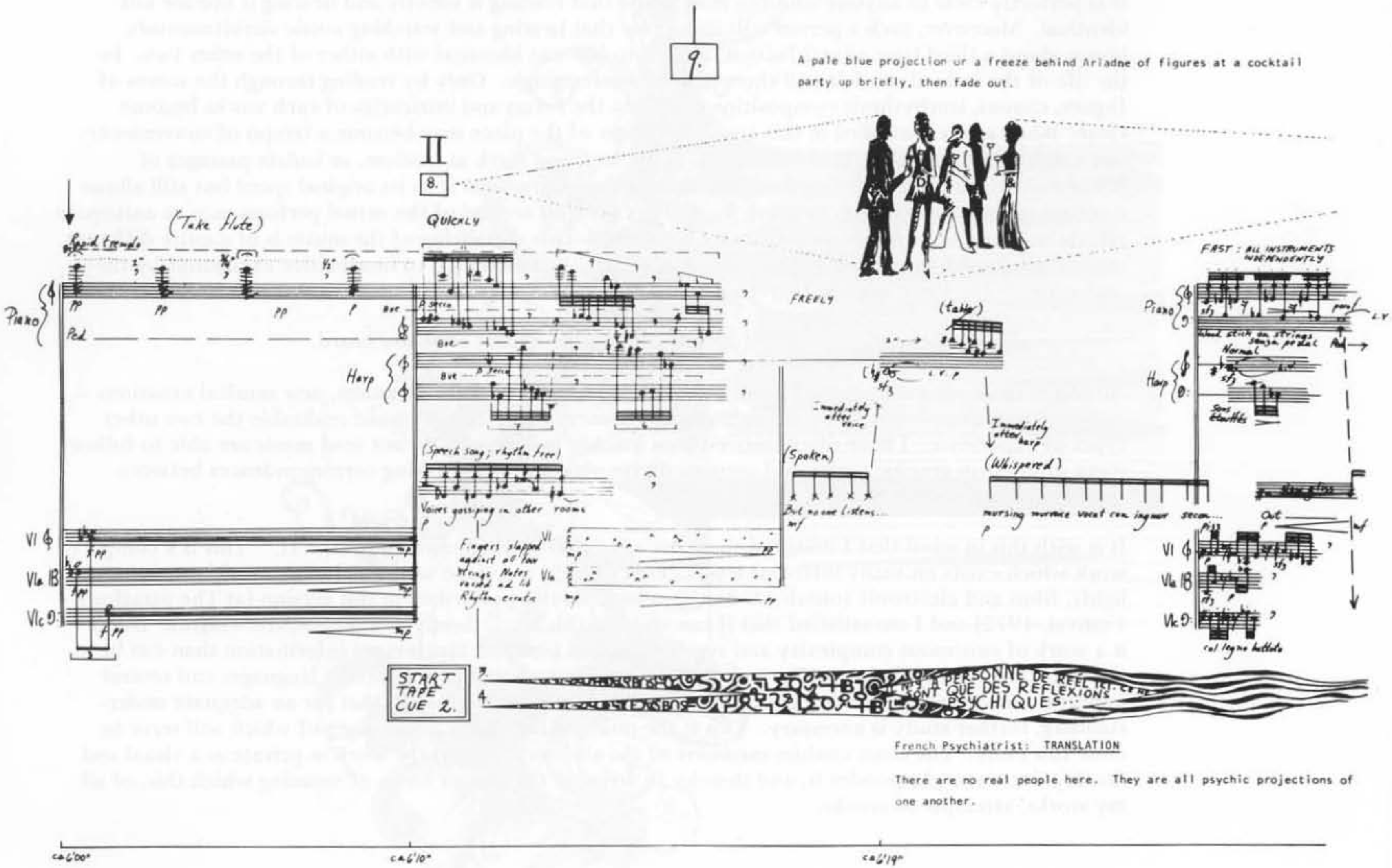
THE THREE MUSICS AND AN APPROACH TO A NEW ART FORM

It is perfectly clear to anyone who can read music that reading it silently and hearing it live are not identical. Moreover, such a person will also know that hearing and watching music simultaneously brings about a third type of satisfaction, related to but not identical with either of the other two. In the life of the trained musician all three activities intermingle. Only by reading through the scores of fugues, canons, isorhythmic compositions, etc., do the forms and intricacies of such works become clear. When music is studied in this way, the tempo of the piece may become a tempo of convenience; one can examine the piece in slow motion, jump back and forth at random, or isolate passages of interest. Watching and listening to music simultaneously restores it to its original speed but still allows a certain amount of freedom to move away from the split second of the actual performance to anticipate effects or examine how certain sounds are produced. This visualizing of the music is of a quite different order than that of the casual listener whose mind may be stimulated to imaginative excursions by the "program." The three musics, therefore, are these:

1) Music seen 2) Music heard 3) Music seen and heard.

Although those who do not read music are deprived of two of these pleasures, new musical notations – audience notations – with a heightened graphic content could help to make realizable the two other types of experience. I have often noticed how quickly people who do not read music are able to follow some of my own graphic scores and seem to derive pleasure from making correspondences between shapes seen and sounds heard.

It is with this in mind that I designed the score of my second stage work, "Patria II." This is a complex work which exists on many different levels. First of all it is a stage work, including musicians, actors, lights, films and electronic sounds. It has been successfully performed in this version (at The Stratford Festival, 1972) and I am satisfied that it can work at this level, if only as a provocative enigma. But it is a work of enormous complexity and symbolism, and contains much more information than can be assimilated at once in this form. For one thing, it employs about twenty foreign languages and several important interpretive clues are given in languages other than English, so that for an adequate understanding, further study is necessary. This is the point of the score, a few pages of which will serve to close this essay. The score enables members of the audience to read the work in private as a visual and literary document, to ponder it, and thereby to arrive at the deeper levels of meaning which this, of all my works, attempts to invoke.


9.
A pale blue projection or a freeze behind Ariadne of figures at a cocktail party up briefly, then fade out.
II
8.
(Take flute)
Rapid tremolo
QUICKLY
Piano
Ped.
Harp
FREELY
(take)
Immediately after voice
Immediately after harp
(Speech song; rhythm free)
Voices gossiping in other rooms
(Spoken)
But no one listens...
(Whispered)
Vl
Vla
Vlc
Fingers slapped against all four strings. Notes varied ad lib. Rhythm erratic
FAST: ALL INSTRUMENTS INDEPENDENTLY
Wood stick on strings
Normal
Sons étouffés
col legno battuto
START TAPE CUE 2.
... PERSONNE DE REEL ICI. CE NE SONT QUE DES REFLEXIONS PSYCHIQUES...
French Psychiatrist: TRANSLATION
There are no real people here. They are all psychic projections of one another.
ca.6'00"
ca.6'10"
ca.6'19"

11.

EDITING UNIT 4
"ALMAGEST"

Ariadne's dead spirit moves about, exploring. Pale light now reveal the shadowy figures of the other inmates in the asylum, slowly moving about in strange, almost ritualistic ways. Some walk backwards or sideways; others move on all fours or crawl. Some of the patients wear masks. Others are deformed in hideous ways.

The scene the patients create must haunt the viewer from the very first and must continue to haunt him throughout the entire work. The mental patients, even when they are not directly involved in the action, are omnipresent in the background. Great care must be taken to "orchestrate" every situation properly with background sound and gesture.

Sometimes the patients are mere shadows. Other times they may have brilliant lumatic effects or projections flashed over them. Sometimes they imitate the action of the protagonists. Thus one inmate may become a Doppelgänger for another. Julie November, for example, has a large array of dolls with which she follows the whole action of the opera.

1. MY WHITE BODY LIES ON THE TABLE... I AM MOVING AWAY FROM IT...

2. (Heavy Breathing on tape)

2. Hungarian Psychiatrist: Csodálatos, hogy milyen szelidek lettek. Serbo-Croatian Nurse: Donjeli smo je smijeste ovamo...

3.

4.

HUNGARIAN PSYCHIATRIST TRANSLATION: Amazing how docile they become.

SERBO-CROATIAN NURSE TRANSLATION: We brought her right here.

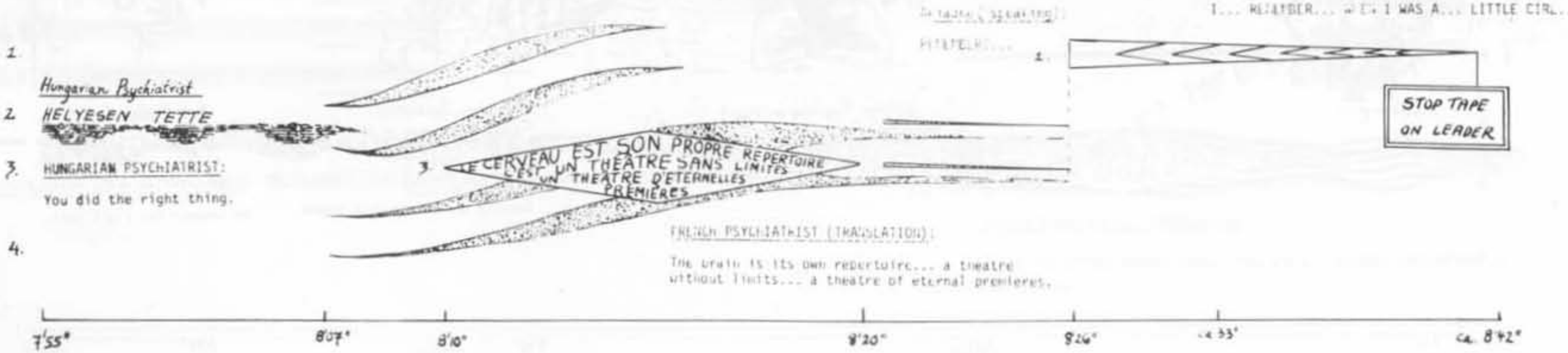
7'24" 7'34" 7'48" 7'52"

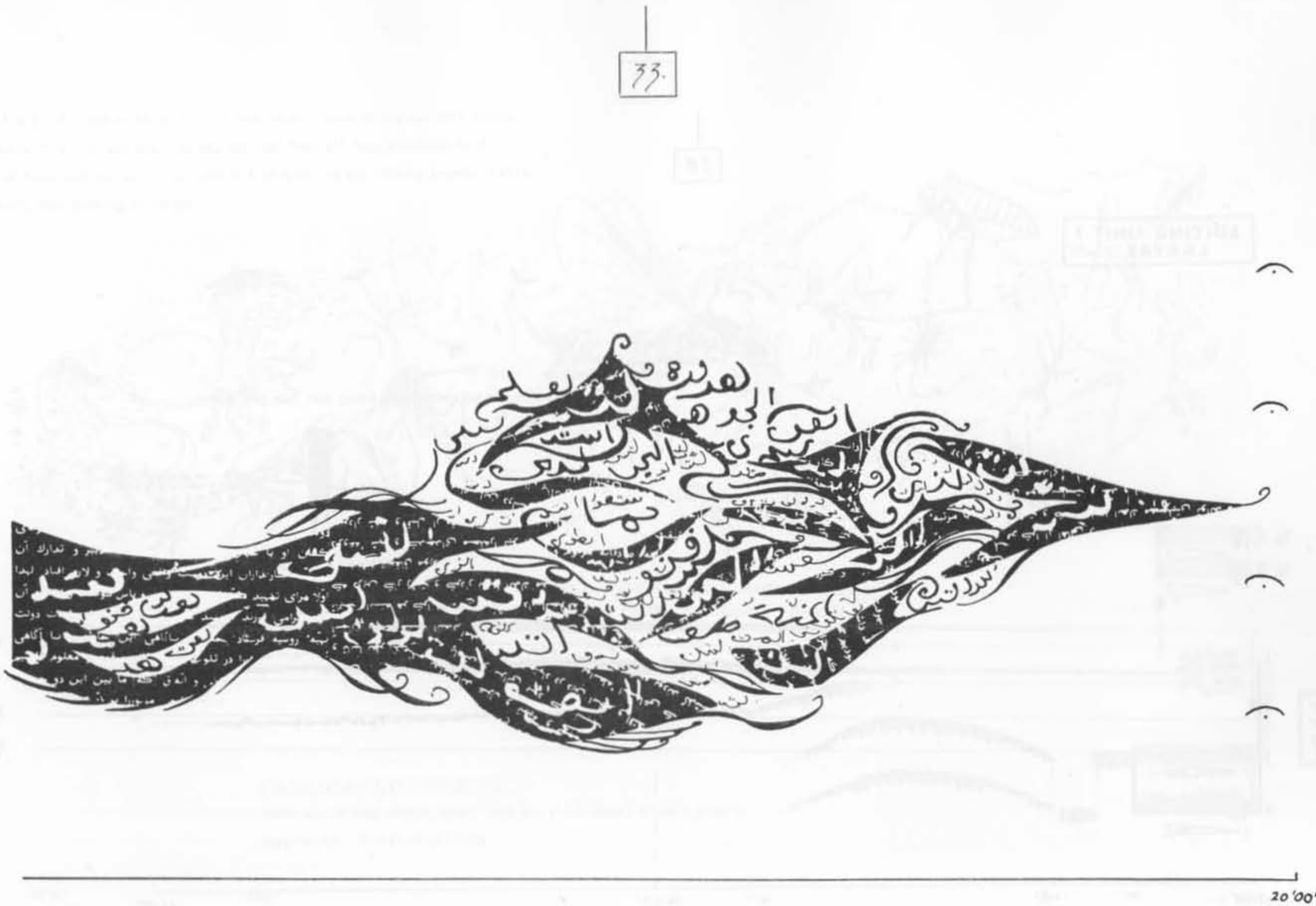
12

Numerous ritualistic games seem to be played, often in slow motion. For instance, some inmates may silently act out dramatic situations drawn from the Tarot cards.

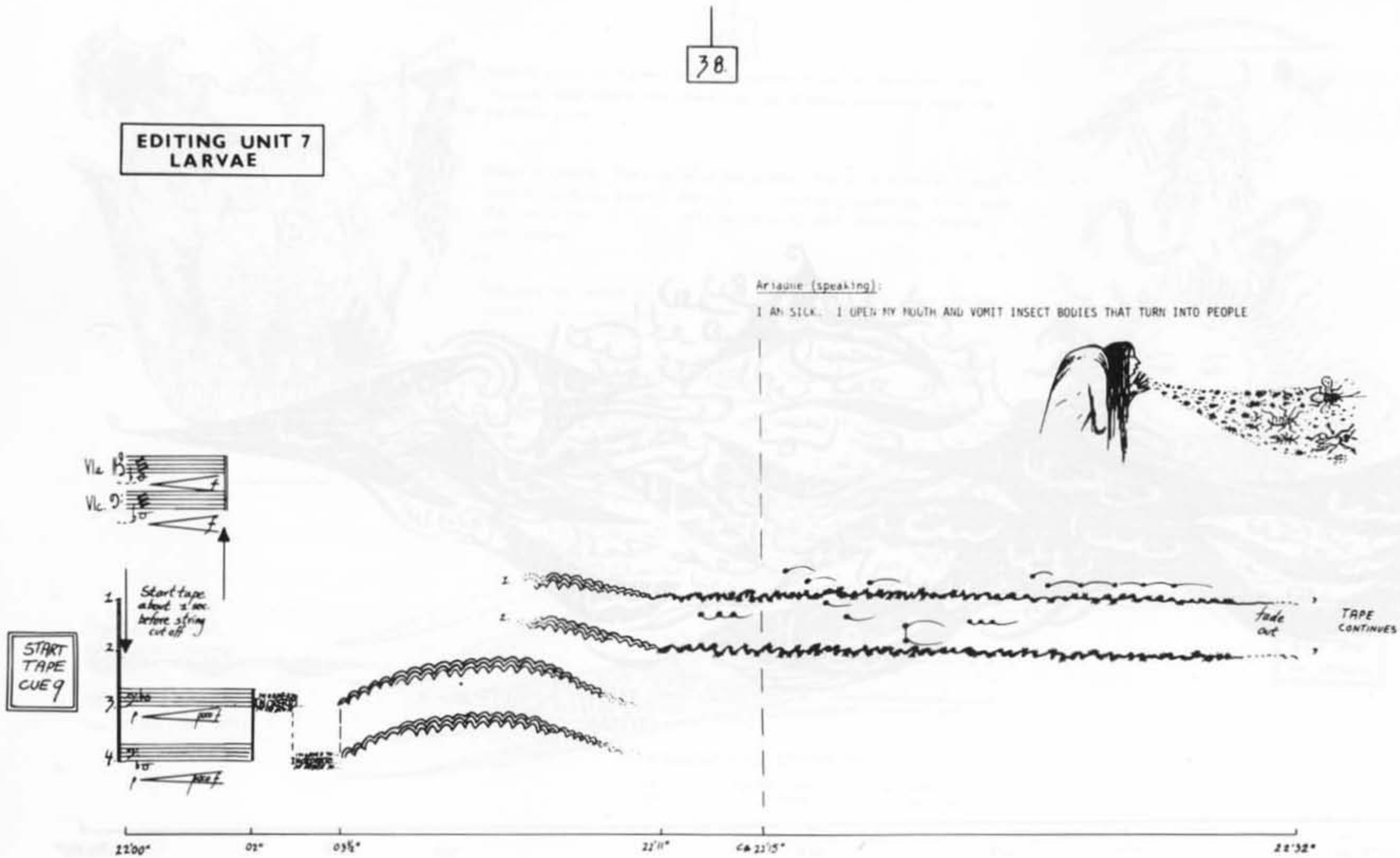
Sounds are heard. Sometimes words and phrases, but often merely pure vocables - laughter, giggles, gurgles, moans, breathing, bleating, panting, roars, gushings, whistlings, hissings, puffs, whispers, screams, murmurings, shrieks, sobs, groans.

Sometimes the inmates will move rapidly, convulsively, other times they may strike mutist postures and hold them indefinitely. Throughout the whole of *Requiems* we must have the feeling of temporal aberration. Time can be made to stand still like dough in a bowl. There is no action on stage, nothing to see or do but wait. At other times a whole universe of activity suddenly erupts and history is made in milliseconds. The inmates in the asylum are the instruments for demonstrating this aberrant and inorganic microcosmos. They are the mischievous epicycles in this [illegible]



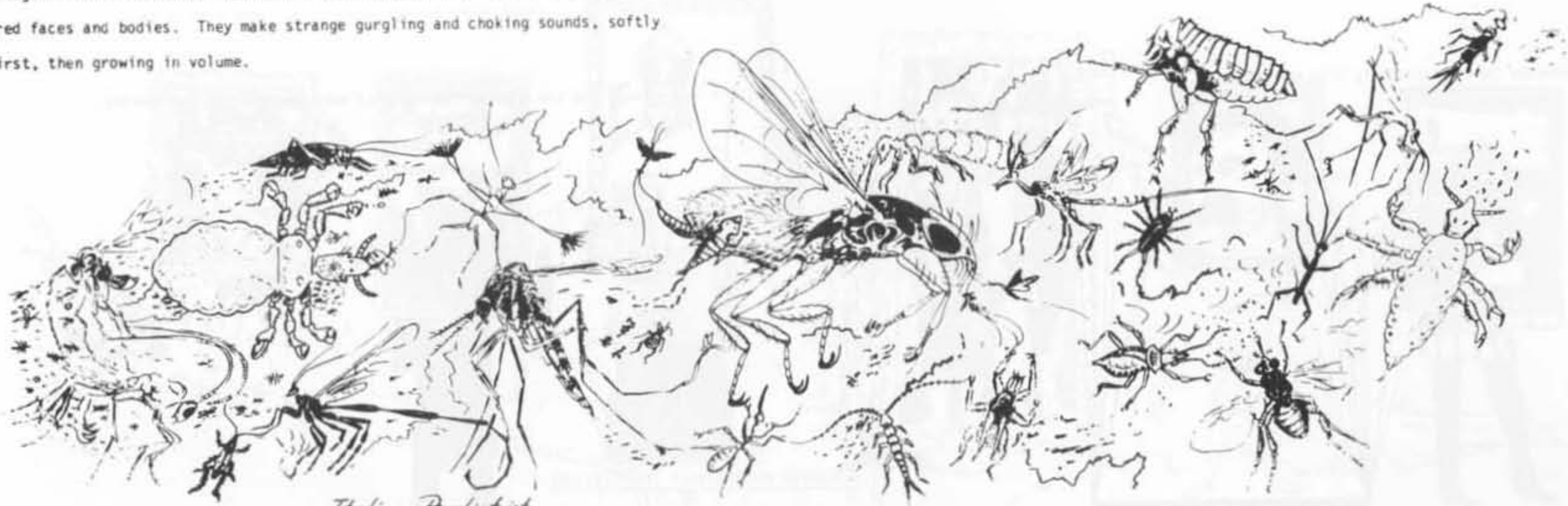

33.
20'00"

EDITING UNIT 7
LARVAE



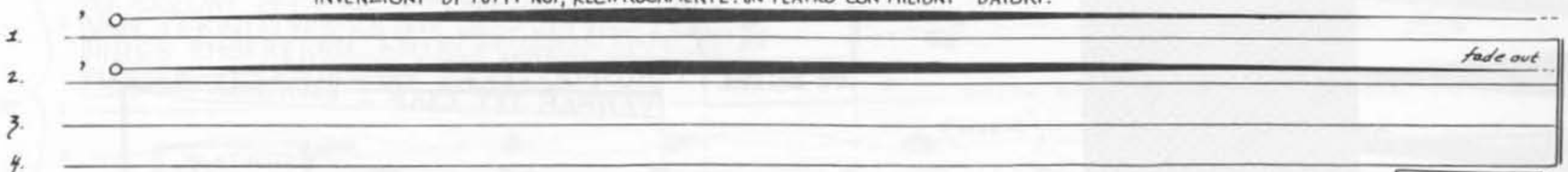
39

Lights begin to come up revealing the inmates once more moving sullenly across the stage in all directions. We now see that they all have misshapen or disfigured faces and bodies. They make strange gurgling and choking sounds, softly at first, then growing in volume.



Italian Psychiatrist

NON CI SONO VERE PERSONE QUI. SONO SOLO INVENZIONE DELL'IMAGINAZIONE: INVENZIONI DI TUTTI NOI, RECIPROCAMENTE. UN TEATRO CON MILIONI D'ATORI.

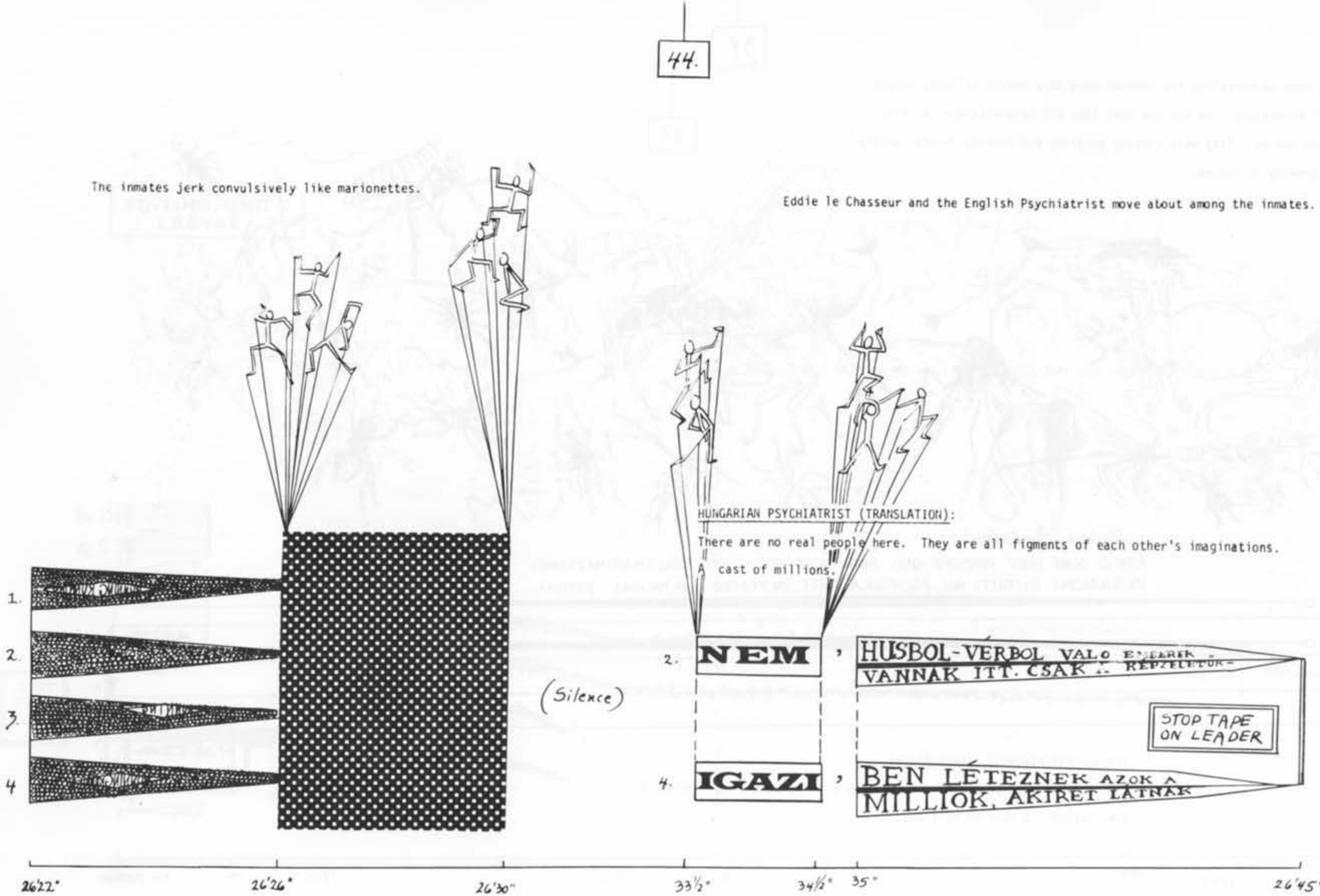


STOP TAPE ON LEADER

ITALIAN PSYCHIATRIST (TRANSLATION):

There are no real people here. They are all figments of each other's imagination. A cast of millions.

22'32" 22'41" ca 22'58"


44.
The inmates jerk convulsively like marionettes.
Eddie le Chasseur and the English Psychiatrist move about among the inmates.
HUNGARIAN PSYCHIATRIST (TRANSLATION):
There are no real people here. They are all figments of each other's imaginations.
A cast of millions.
1.
2.
3.
4
(Silence)
2.
NEM
,
HUSBOL-VERBOL VALO
VANNAK ITT. CSAK
4.
IGAZI
,
BEN LETEZNEK AZOK A
MILLIOK, AKIRET LATNAK
STOP TAPE ON LEADER
26'22"
26'26"
26'30"
33½"
34½"
35"
26'45"

67.

Inmates hold heavy gilt frames before their faces.

TAPE

1. AS ASSZONY MEGY FEL A LÉPCSÖN, AHOL VALAMI PARTI VAN. TEKINTÉLYES KÜLSEJÜ HÖLGY NYIT AJTÓT. A HALLBAN HIRES EMBEREKRÖL, KÖZTÜK NIETZSCHERÖL KÉSZÜLT FESTMÉNYEK. MINDEGYIKNEK SZINES BROKÁDBÓL VAN A RUHÁJA.

2. WHILE THE LADY IS DESCRIBING THE PAINTINGS ONE SUDDENLY COMES TO LIFE.

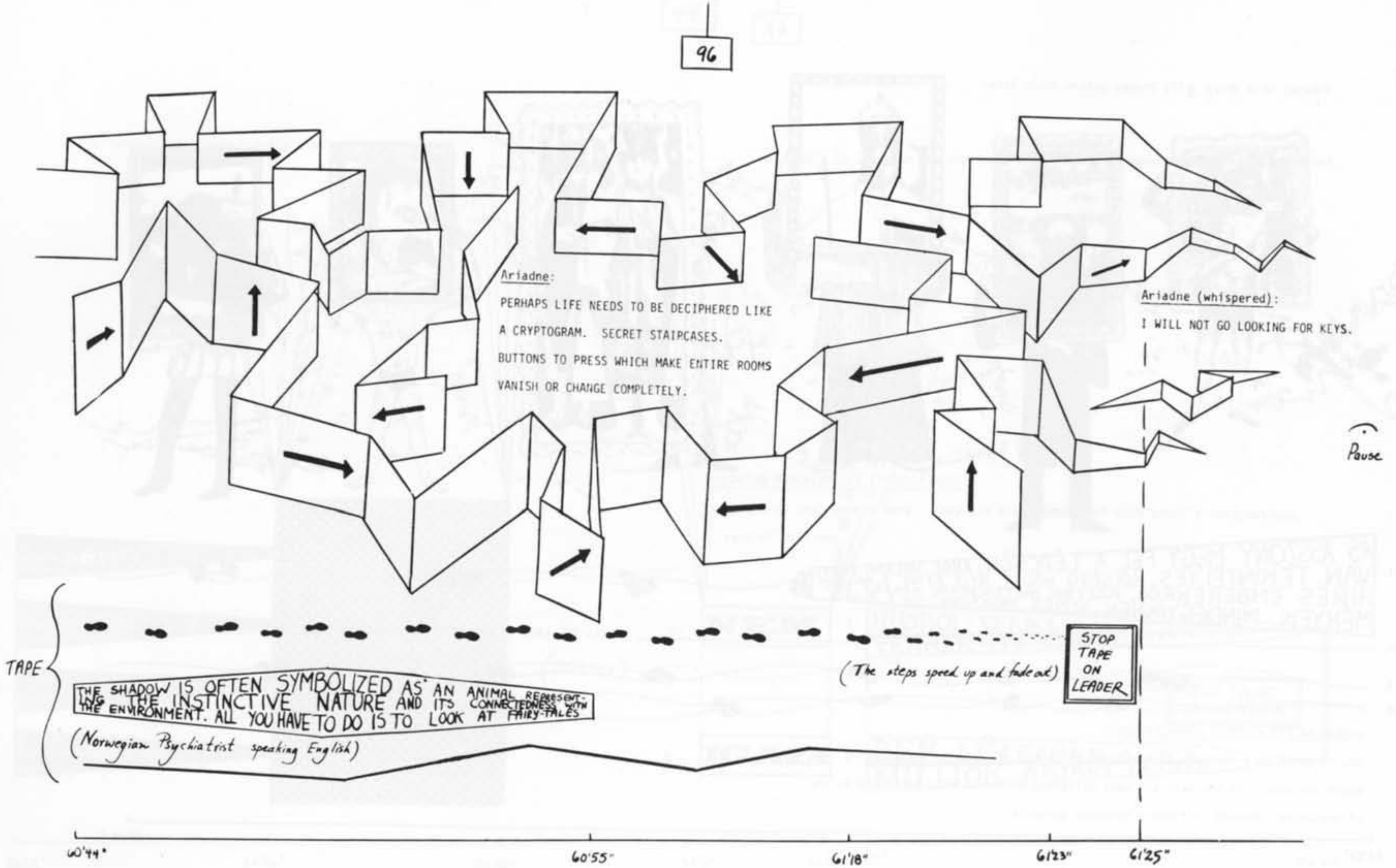
3.

4.

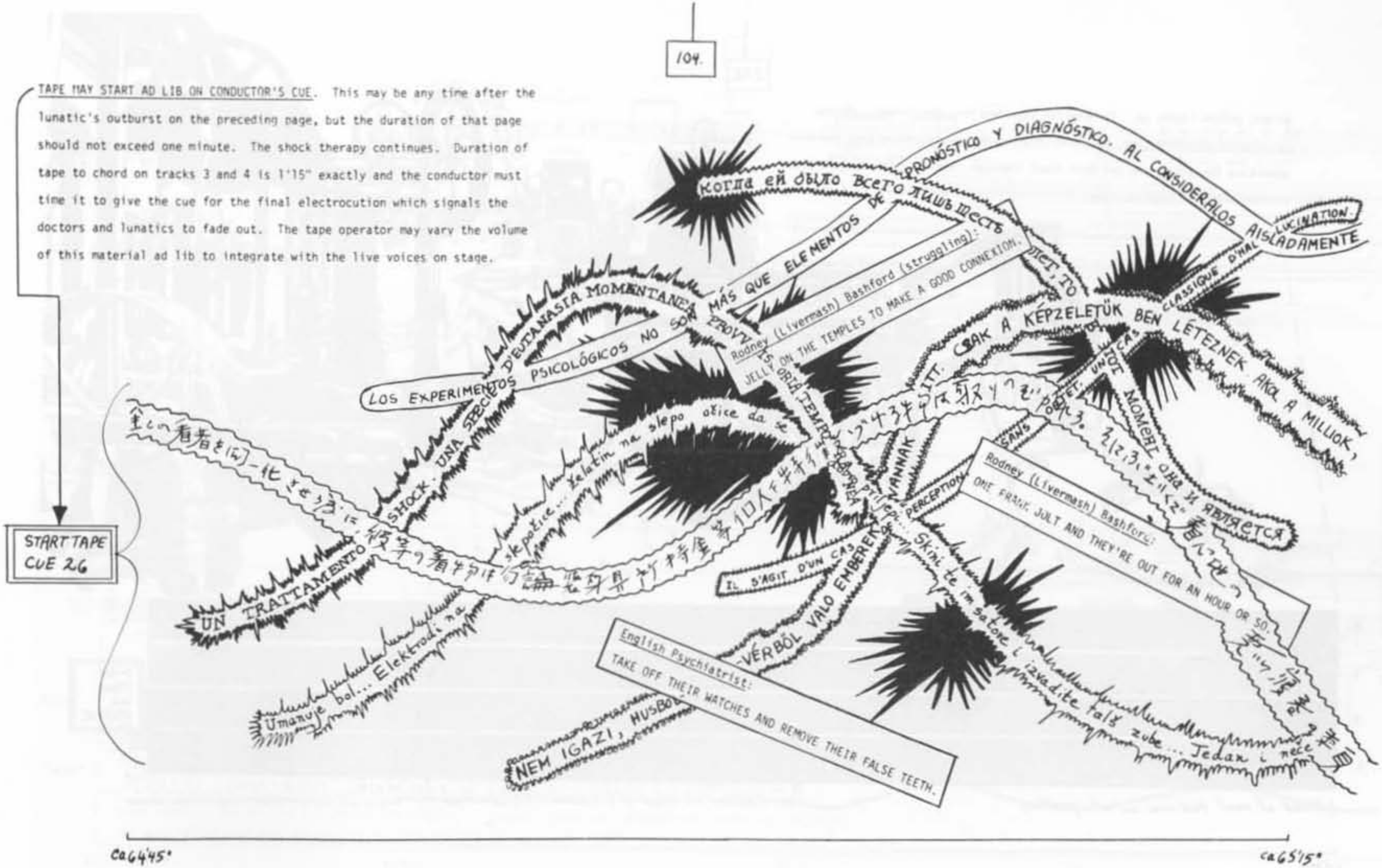
HUNGARIAN PSYCHIATRIST (TRANSLATION):

She is going up a stairway to some kind of party. A distinguished-looking lady opens the door. In the hall she sees paintings of famous men, particularly one of Nietzsche, dressed in flowery brocaded garments.

43'33" 44'14"

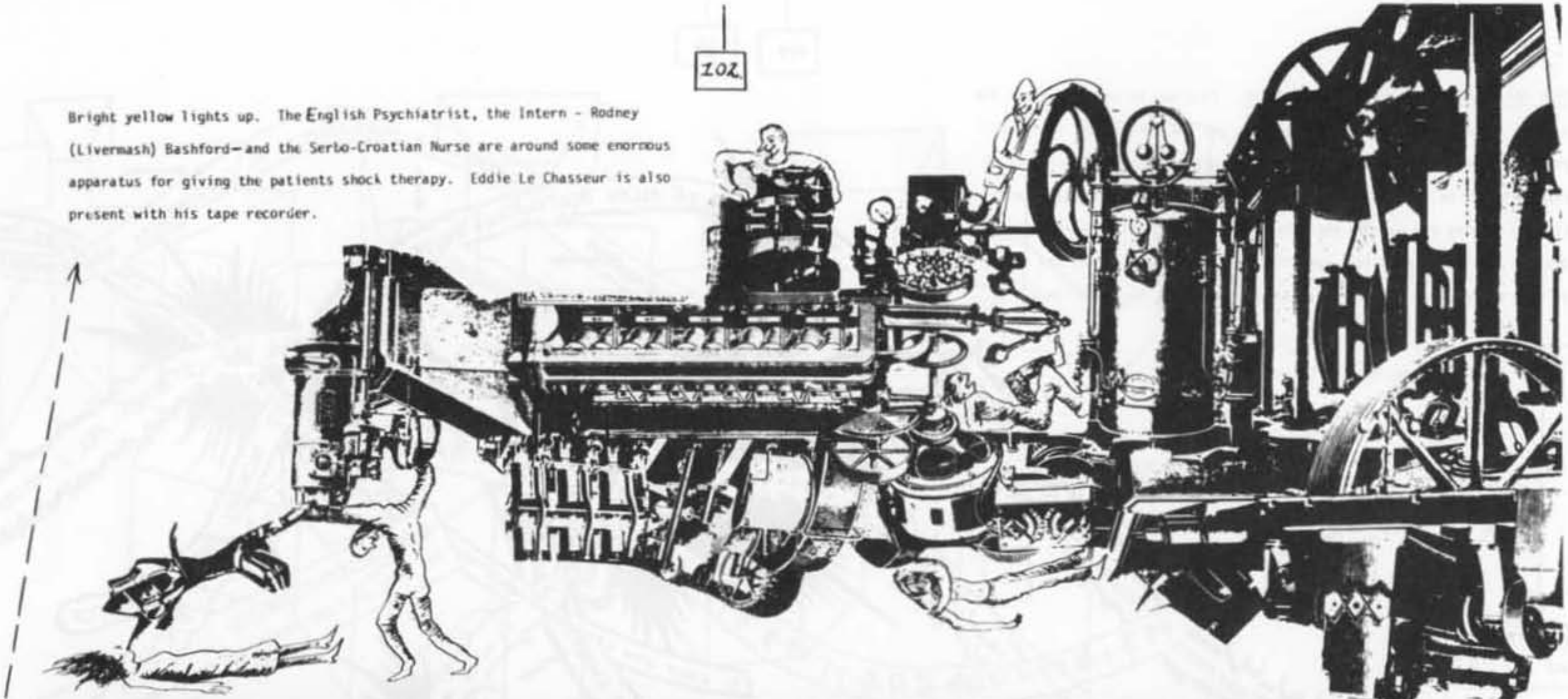


96
Ariadne:
PERHAPS LIFE NEEDS TO BE DECIPHERED LIKE A CRYPTOGRAM. SECRET STAIRCASES. BUTTONS TO PRESS WHICH MAKE ENTIRE ROOMS VANISH OR CHANGE COMPLETELY.
Ariadne (whispered):
I WILL NOT GO LOOKING FOR KEYS.
Pause
TAPE
THE SHADOW IS OFTEN SYMBOLIZED AS AN ANIMAL REPRESENTING THE INSTINCTIVE NATURE AND ITS CONNECTEDNESS WITH THE ENVIRONMENT. ALL YOU HAVE TO DO IS TO LOOK AT FAIRY-TALES
(Norwegian Psychiatrist speaking English)
(The steps speed up and fade out)
STOP TAPE ON LEADER
60'44"
60'55"
61'18"
61'23"
61'25"

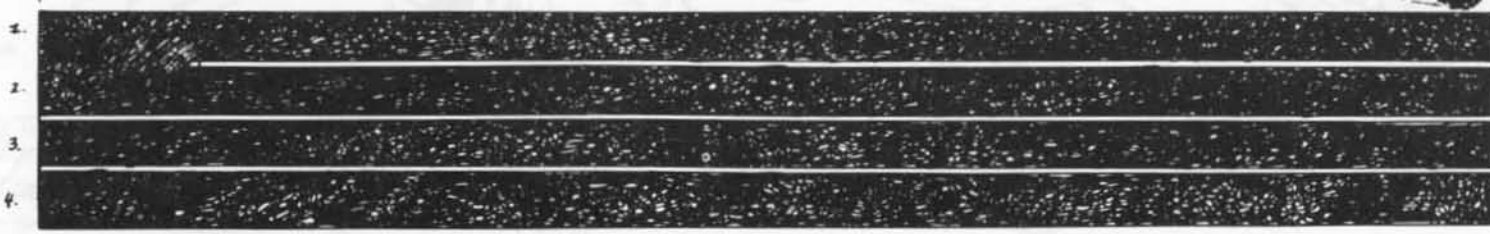

104.
TAPE MAY START AD LIB ON CONDUCTOR'S CUE. This may be any time after the lunatic's outburst on the preceding page, but the duration of that page should not exceed one minute. The shock therapy continues. Duration of tape to chord on tracks 3 and 4 is 1'15" exactly and the conductor must time it to give the cue for the final electrocution which signals the doctors and lunatics to fade out. The tape operator may vary the volume of this material ad lib to integrate with the live voices on stage.
START TAPE CUE 26
LOS EXPERIMENTOS PSICOLÓGICOS NO SON MÁS QUE ELEMENTOS DE PRONÓSTICO Y DIAGNÓSTICO. AL CONSIDERALOS AISLADAMENTE
Rodney (Livermash) Bashford (struggling):
JELLY ON THE TEMPLES TO MAKE A GOOD CONNEXION.
CSAK A KÉPZELETÜK BEN LÉTEZNEK AKA A MILLIOK,
Rodney (Livermash) Bashford:
ONE FRANK JOLT AND THEY'RE OUT FOR AN HOUR OR SO.
English Psychiatrist:
TAKE OFF THEIR WATCHES AND REMOVE THEIR FALSE TEETH.
UN TRATTAMENTO SHOCK: UNA SPECIE D'EUTANASIA MOMENTANEA
NEM IGAZI,
ca 4'45"
ca 6'15"

202

Bright yellow lights up. The English Psychiatrist, the Intern - Rodney (Livermash) Bashford—and the Serbo-Croatian Nurse are around some enormous apparatus for giving the patients shock therapy. Eddie Le Chasseur is also present with his tape recorder.



TAPE

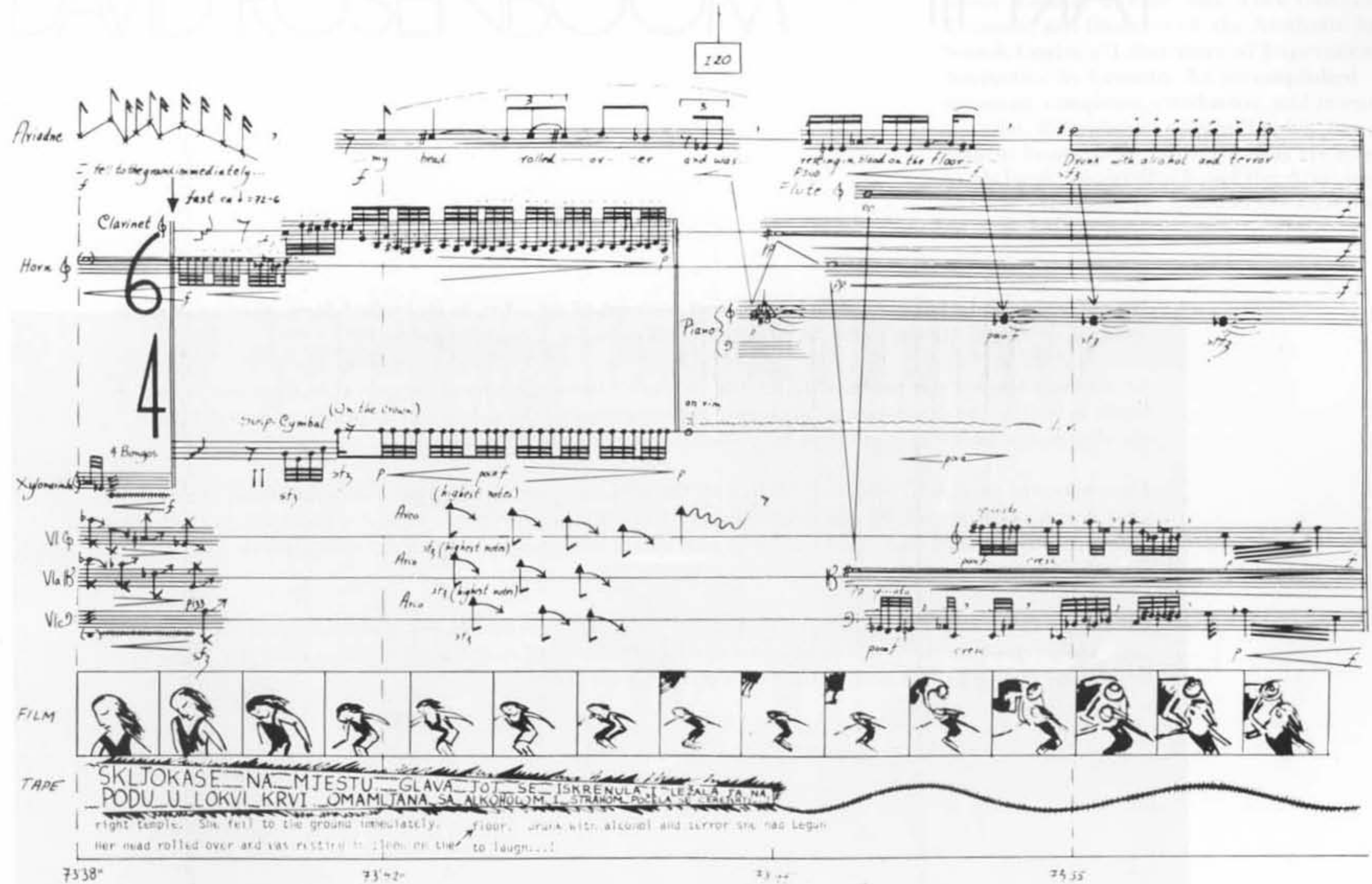


STOP TAPE ON LEADER

(A wall of sound fortissimo on all speakers)

63'38"

63'48"


120
Ariadne
my head rolled over and was
reeking in blood on the floor
Drunk with alcohol and terror
fell to the ground immediately
Flute
Clarinet
Horn
Piano
Susp. Cymbal
(On the crown)
4 Bongos
Arco
(highest notes)
Vl
Vla
Vlc
FILM
TAPE
SKLJOKASE NA MJESTU GLAVA JOJ SE ISKRENULA I
PODU U LOKVI KRVI OMAMLJANA SA ALKOHOLOM I STRAHOM
right temple. She fell to the ground immediately.
floor. Drunk with alcohol and terror she had begun
to laugh...!
73'38"
73'42"
73'55"

PART III

We enter a period of a more global and direct concept of art. Art, in its *highest* form, may soon cease to exist as a conventional material medium. This includes Sound Sculpture.

Endeavours toward this probability involve extensive investigations of the perceptual process on all levels as well as the development of deeper appreciations of the values of the primitive and childlike, the dream, the immediate intuitive response, bio-psychic energies, and so on.

Currently, the view held by many centres on the idea that one of the great cultural endeavours of the next few generations will be the development of an empirical synthesis between the sciences (including our oldest science: music) and other modes of perceptual consciousness (such as: the aesthetic experience; mystical traditions; etc.).

The following artists serve to illustrate some of the initial approaches being made toward this end. They represent the possible beginnings of a new breed of sound sculptor, and the early developmental steps of a new, profoundly powerful art form.

Ed.

DAVID ROSENBOOM

Born in 1947. Educated at various universities in the United States. Currently Assistant Professor, Faculty of Fine Arts, York University, Toronto, and Director of the Aesthetic Re-Search Centre's 'Laboratory of Experimental Aesthetics' in Toronto. An accomplished musician, composer, conductor, and research scientist, Rosenboom now makes his permanent home in Toronto. Readers are referred to his book 'Biofeedback and the Arts: results of early experiments', listed in the References on page 195.

David Rosenboom

Vancouver Piece*

by David Rosenboom

An acoustically sealed, light tight room is constructed, with treated walls for low reverberance. Two sound radiators, reproducing two separate channels of white noise sources, are installed in the ceiling so as to create two cones of sound radiation spreading from the ceiling to the floor. The areas of radiation of the two cones do not overlap. The spread of the sound cones is dependent on frequency, the high frequencies spreading to describe small circles on the room's floor and the low frequencies describing large but nonoverlapping circles. The result is an invisible, static airpressure sculpture, changes in which can only be experienced by moving around the space.

In the centre of the white noise sound cones is either a small red or green, low intensity spot light. In the centre of the room is a half aluminized mylar mirror system. Nothing happens in the room until it is activated by two participants as follows. Two persons enter and sit on the floor in the centre of the sound cones, facing one another and the two-way mirror system. Electrodes are attached by an attendant to monitor their brains' Alpha wave output. When one person is producing Alpha brain waves, the red or green light above him will come on so as to illuminate his face. That person will then see himself in the mirror system and his partner will also see him. This works vice versa for the partner as well. If, however, the two persons are able to produce coordinated Alpha wave bursts, at the same time with each other, they will both be illuminated and their faces will superimpose in the mirror system. They will see both faces superimposed on both sets of shoulders. The room is constructed and painted so as to eliminate the sensation of being in a bounded space. One is not aware of the room's cubical shape. Once these bounds have been removed, however, an artificial bound in the form of horizon lines is created in the space. This simulates the one spatial bound Earth beings cannot escape, that created by the line where the sky meets the ground. Several thin plastic fibers of rods are installed on the walls. Wisps of very faint light race around the room in response to the Alpha production of the participants. The horizon constantly fades in and out as Alpha and the eye's image effects operate normally.

*A Sound Sculpture Environment designed for the Vancouver Art Gallery's Sound/Sculpture exhibit.

Statements displayed at the entrance to the 'Vancouver Piece' room:

AIR PRESSURE SCULPTURE

Sonic vibrations in a closed space arrange the air in standing, high and low pressure patterns forming an invisible air pressure sculpture. Walk through and see it with your ears.

MATERIALS PROVIDED TO ENERGIZE THE SPACE

SILENCE -listen to your own internal sounds
WHITE NOISE -randomly changing sound energy
SINE WAVES -regularly changing sound energy
'PORTABLE GOLD AND PHILOSOPHERS' STONES' -Alpha brain wave music
'DUET FOR TWELVE TRUMPETS' -music by David Rosenboom

BIOFEEDBACK MEDITATION SPACE

Possibilities: Use Theta brain waves to relax and clean the system and experiment with daydreams. Use Alpha brain waves to explore the modalities of perception and organization of information and experience. When these brain waves are detected, 'horizon line light whisps' will appear, red and green illumination will increase and sound pulse waves will be heard.

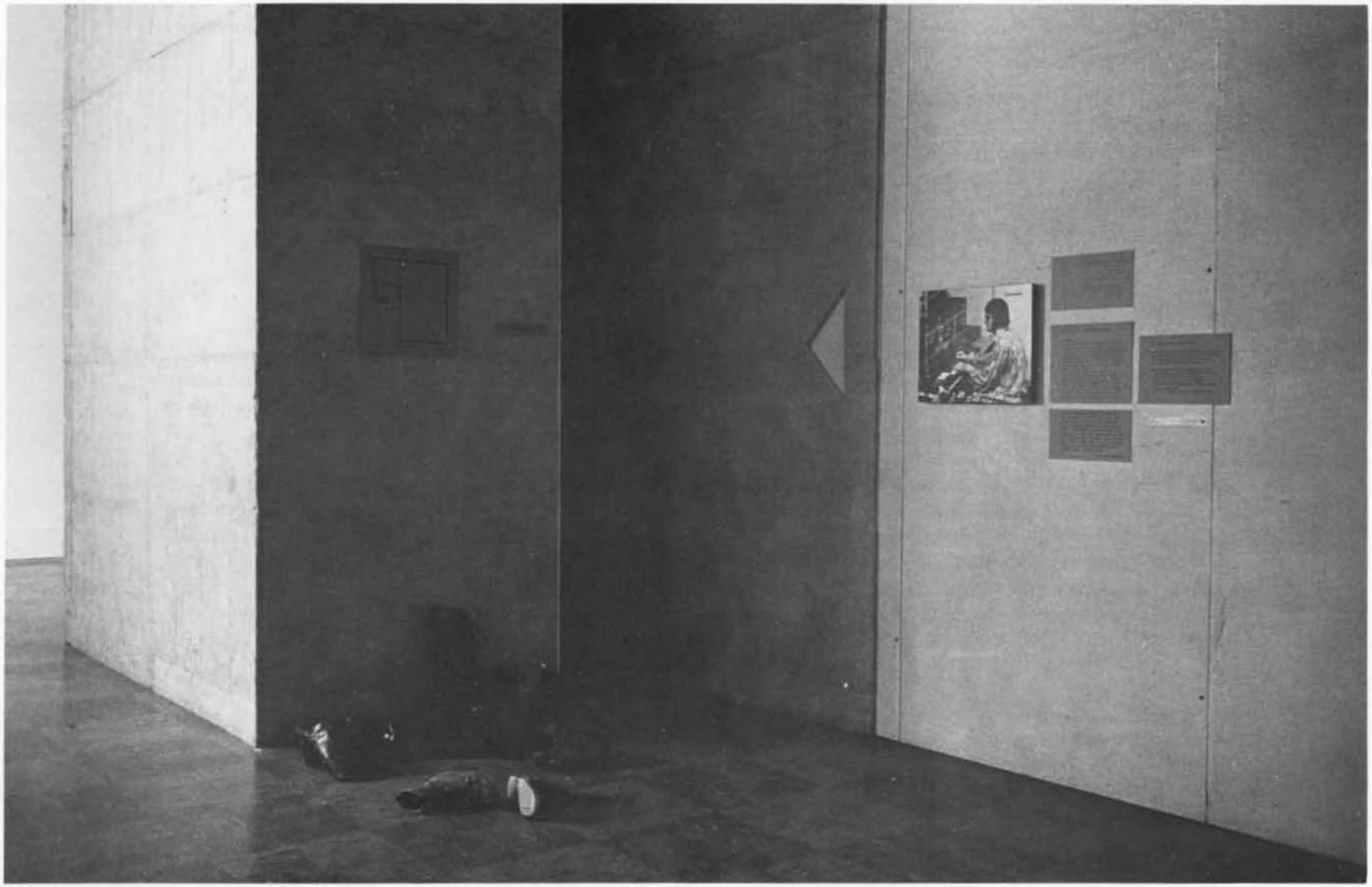
With a partner, 'visual dual Alpha' may be experienced. Sit under the red or green light facing the half silvered mirror. Your partner sits on the opposite side of the mirror. When either of you produce Alpha alone, you will see only yourselves. When you produce Alpha together, your faces will superimpose on each other.

When no one is wired to the system, the room will play back other people's previous experiences for the observers.

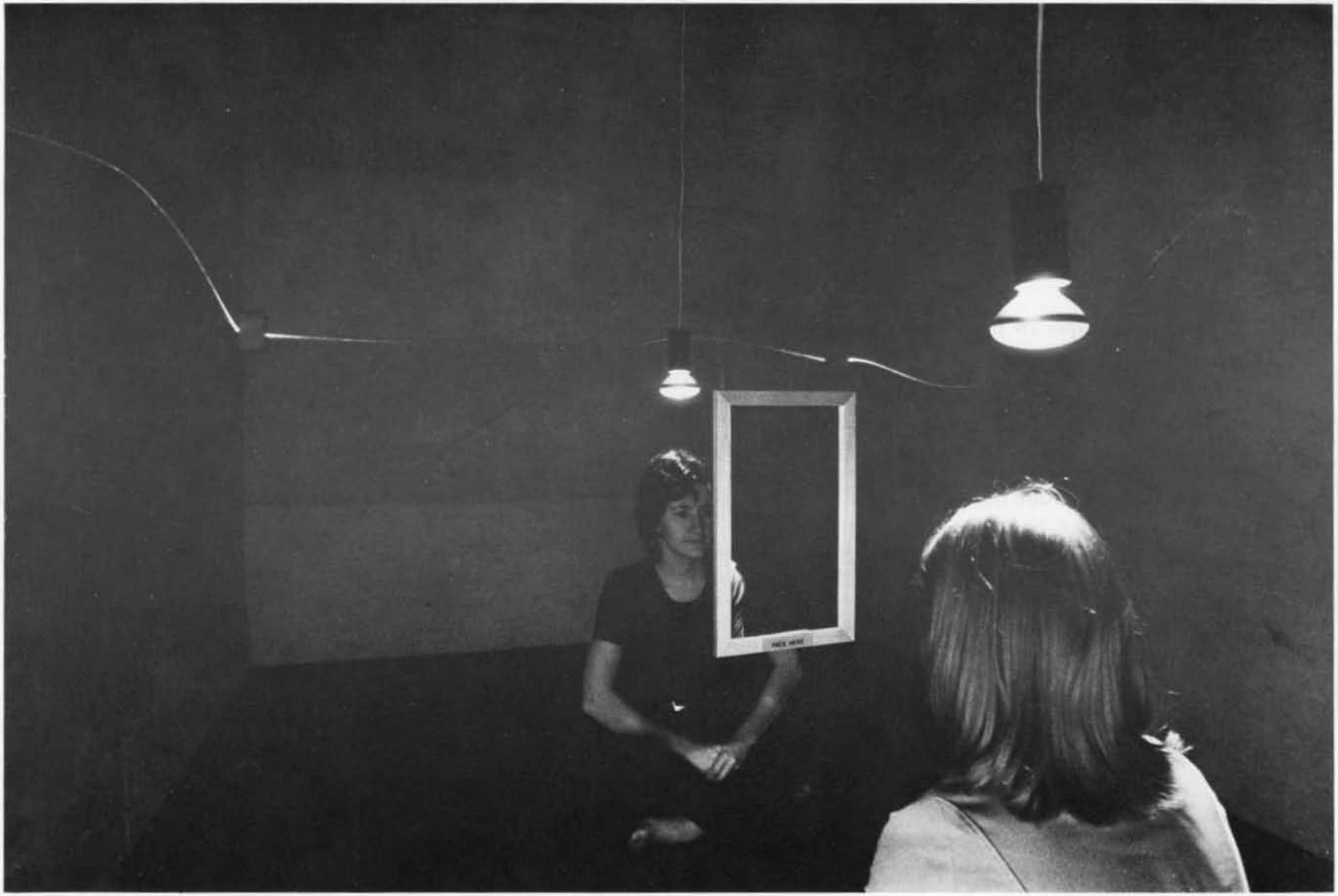
STATEMENT ABOUT SPONTANEOUS VISUAL NOISE

When the intensity of light on a surface is just about at the threshold for seeing in the totally dark-adapted state, each rod in the retina absorbs an average of about one quantum per hour. Since a flash is visible when about nine quanta are absorbed by nine rods within about 10 minutes of arc of each other and within about 0.1 seconds, then a visual event should be expected about once every 3 seconds in each square degree of the wall. (Ref. Cornsweet, T.: *Visual Perception*, Academic Press, New York, 1971.)

Reference: see page 195



Entrance to Rosenboom's 'Vancouver Piece' at the Vancouver Art Gallery.



David Rosenboom's 'Vancouver Piece'.

WALTER WRIGHT

Born 1941 in Ottawa. Studied at University of Manitoba (B.Arch.), University of Waterloo (M.A.Sc., in Design), postgraduate research at University of Toronto. Moved to New York in 1969, worked with computer graphics and video synthesis. Works as a computer animator for Computer Image Corporation. Produces videotapes out of the Kitchen (an electronic video lab in New York).

Videotape Kitchen Notes

My tapes are made on the Scanimate "computer" system built by Computer Image Corporation. Scanimate is a first generation video synthesizer. Images are input in a number of ways – thru (2) 1000-line black and white vidicon cameras (these cameras may look at still artwork, a TV monitor, etc.), from an Ampex 2-inch VTR, or from a studio camera. Two of these input channels pass thru a video mixer to the Scanimate CPU (main control unit) where position and size of the image are controlled. The input TV raster may be repositioned right or left, up or down; it may be reduced in width or length (height); it may be reduced in overall size to a point or thru a point reappearing inverted and mirror image.

Also on the CPU are (3) oscillators. The horizontal oscillator repositions the raster lines left to right producing a wave-like distortion running up or down thru the TV image. The vertical oscillator repositions the raster lines up and down producing a rolling distortion. The depth oscillator affects the overall size of the raster producing at low frequencies a pulsating zoom and at higher frequencies a 3-D roll distortion. The CPU also controls the axes (the lines about which an image folds), and allows the image to be broken into as many as (5) separate sections.

The Animation Aid provides (5) more oscillators, timing control, and a patchboard allowing separate control over individual sections. There are (2) high-speed oscillators (15 kHz up) which may be phase-locked to the horizontal synch pulse (low-speed oscillators lock to the vertical synch pulse). There is a special pair of oscillators running 90-degrees out of phase which are used to generate circles, spirals, and diamond shapes. And finally, one additional low-speed oscillator similar to those on the CPU. The oscillators on the Animation Aid allow amplitude modulation. Thru the patchboard these oscillators may drive horizontal, vertical, depth, width, length, axes, or intensity.

The animated image is output from the CPU to a high-resolution CRT display. It is rescanned with a plumbicon camera at standard TV rates (525 lines per frame). The output of the rescan camera goes to the Colorizer.

At the input to the Colorizer the image is encoded in (5) grey levels. Any color may be keyed over a grey level by using the Red, Green, Blue slider pots assigned to that level. The electronically colored image then goes to a switcher where other video signals may be mixed, keyed, or become a background replacing one of the five grey levels.

I play Scanimate as an instrument and all my tapes are made in real time without pre-programming. I also try to avoid editing. I am designing and hope to build a live performance video synthesizer using components of the Scanimate system and adding portable cameras, an 8-level colorizer, a controlled feedback loop and 1/2-inch and 1-inch color tape input and output. Most of my tapes have a score as in music. I am slowly developing a notation system representing the basic animations available on a video synthesizer. I include with these notes a brief outline of these notation symbols and one score.

Notation for Video Synthesizer

horiz animation of TV raster

horiz animation using a high speed oscillator

vertical animation of TV raster

vertical animation using a high speed oscillator

depth animation (simultaneous animation of length & width)

width animation

intensity modulation of video signal

rotation animation, (2) oscillators 90° out of phase.

w – wave form S - sine, T - triangle

f - frequency 1 - 60Hz, 2 - 120Hz, 3 - 180hz, etc.

ϕ - phase lock, low speed osc's lock to vert synch, hi speed to horiz

$\triangledown$ - low amplitude.

A - hi amplitude.

manual control over amplitude.

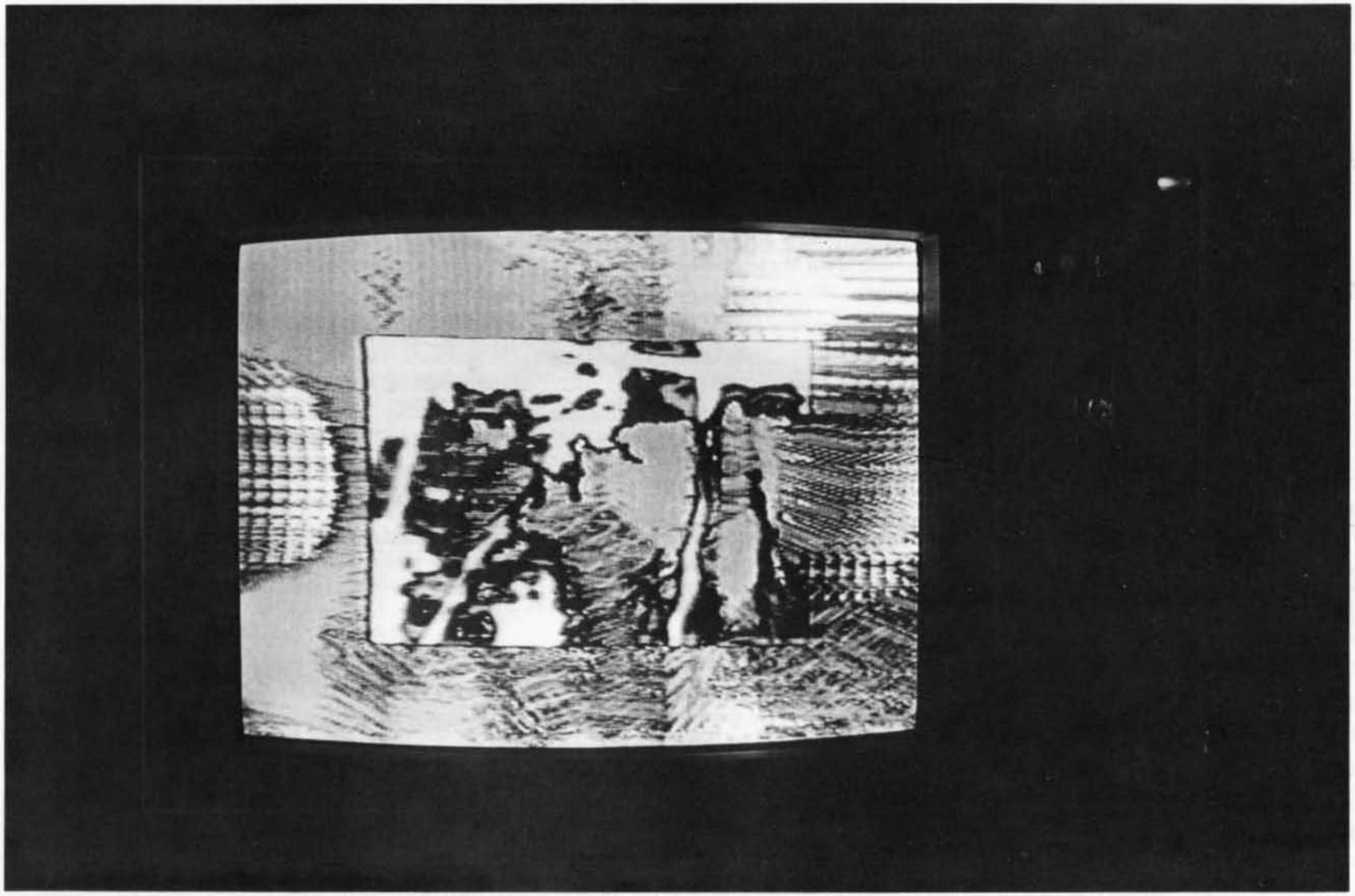
AM - amplitude modulation eg $_S\,_3AM,\,_3low^{\phi}_{0\text{-}1}$ (Spiral).

zoom back

zoom up.

fold in width

fold in length.

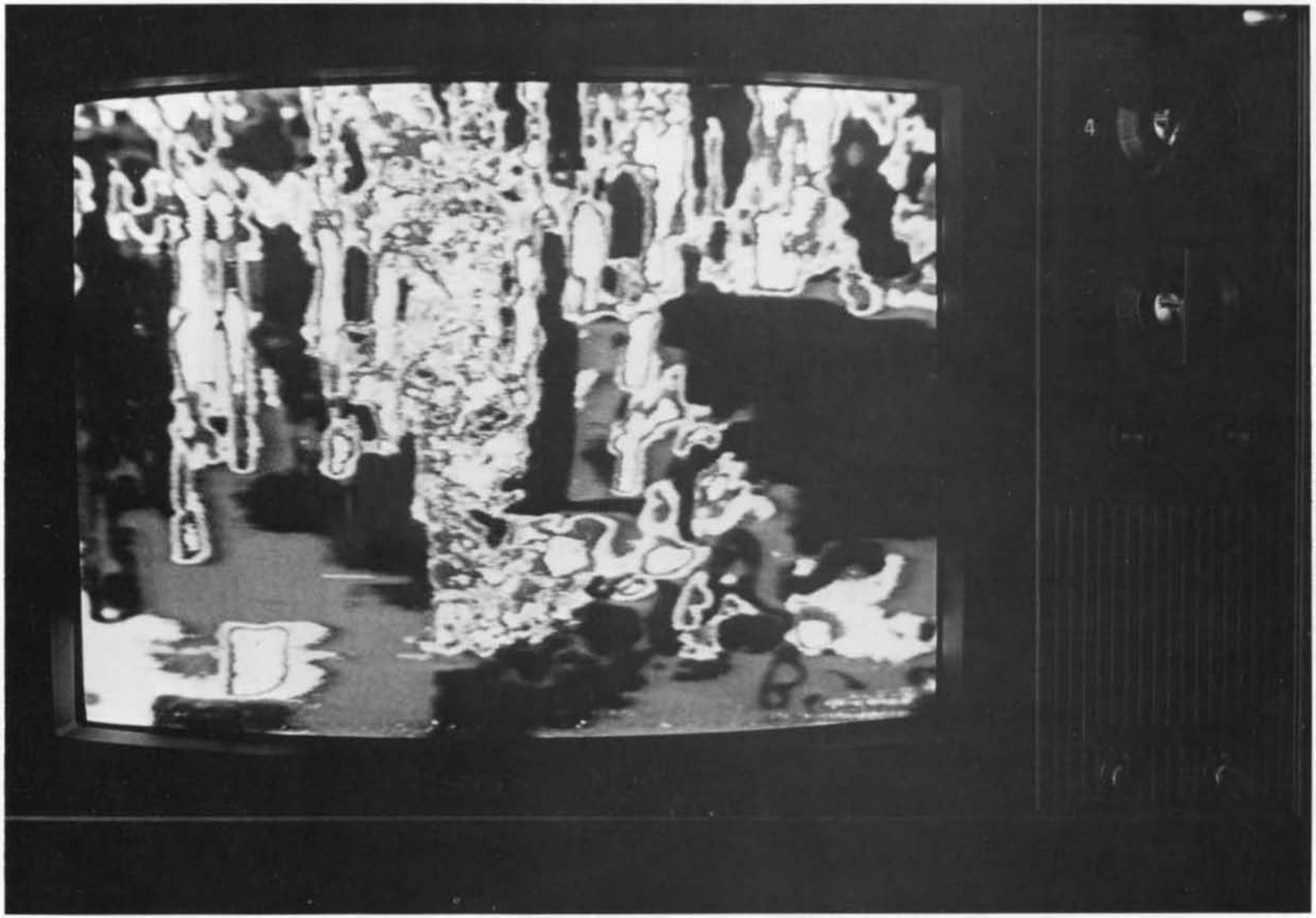


Paper Shoes
October 7, 1972

2-inch quad hiband color

animation of two basic cells (one of horizontal lines, the other vertical lines) done in two passes; first pass becomes background over which second pass is keyed

track is Paper Shoes by Yoko Ono



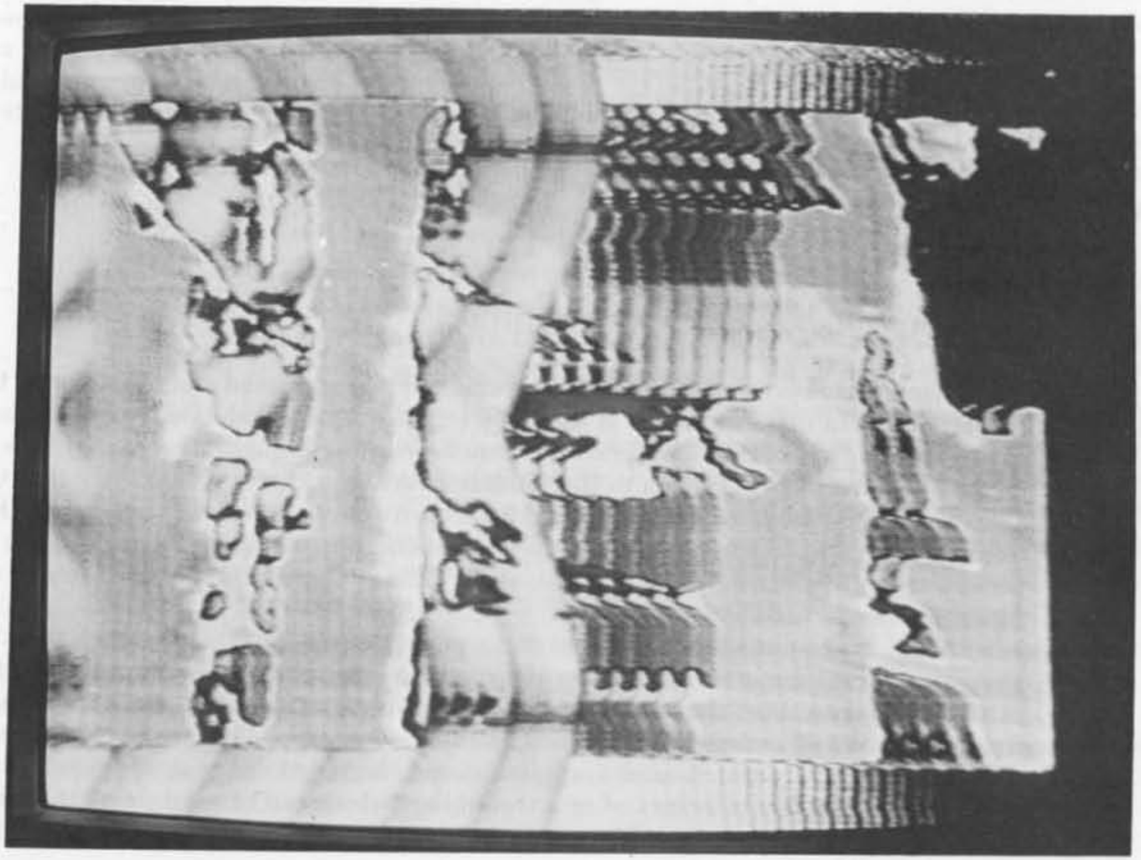
Mahavishnu – Take Two
November 5, 1972

1/2-inch Panasonic color

simultaneous animation using (2) Scanimate video synthesizers (foreground and background) and one abstract cell

Composition for Video Synthesizer #4 8/19/72

	video	animation	color	audio
		color bars.		1 3
1	B	$\nabla_s \mathcal{E}_4$, $\nabla_s \oplus_2$ $_s\Omega_1$ AM $_s\mathrm{low}^{\phi}_{0\text{-}1}$ (spiral) fade vert, depth $\nabla_T \Sigma_{1½}$, all off	$\triangleright O_1, B_2, BG_3, G_4, R_5$ Δ W_1, BG_2	
2	M	$\nabla_s M_3, \nabla_s \Omega_3$ AM$({}_s\mathrm{hi}^{\phi}_{0\text{-}1} + {}_s\mathrm{low}_{0\text{-}1})$	$\triangleleft Bl_{1\text{-}2}, W_{3\text{-}5}$ Y_1, P_2, B_3, G_4, R_5	2 3
3		$(\nabla_s \oplus_1, {}_s\oplus_{0\text{-}4})$ thru zero fade off depth, at point $_s\Omega_1$ AM $_s\mathrm{low}_{0\text{-}1}$, $_s M_{0\text{-}1}$	$\Delta W_1, B_2$ $\triangleright$	1 2 3 1 2 3
4	M	repeat 2 use $\nabla_s M_3$ $_s\mathcal{E}_{3\text{-}1}$ $_s\mathcal{E}_{1\text{-}3}$, $_T\Sigma_3$ vert off $_T\Sigma_{3\text{-}1}$	Δ $\triangleright Bl_1, R_2, G_3, O_4, Y_5$	1 3
5	B mix. salt + pepper.	feedback $\nabla_T \Sigma_{1½}$ titles. $_s\Omega_1$ AM $_s\mathrm{hi}^{\phi}_{0\text{-}1}$	$\Delta Bl_1, W_2, Bl_{3\text{-}5}$ B_1, O_2	3



Trees
January 14, 1973
1/2-inch Panasonic color

pre-recorded 1/4 inch tape used as foreground image; (2) Scanimate video synthesizers with optical and electronic feedback.

DAVID ROTHENBERG

Composer/mathematician David Rothenberg, during the last decade has been carrying out extensive theoretical and applied research, working toward an inter-meshed audio-visual language. This has now been accomplished. Here is a brief essay by Rothenberg outlining its usefulness to artists of all types. Two of his numerous and highly technical papers are given as references on page 195.

Visual Music – A New Art Form

I: PREREQUISITES FOR A NEW MEDIUM

Aside from the obvious requirements of social and personal need and of adequate technical resources, the development of an art medium normally requires a long evolutionary development. Music has existed for a least six thousand years. Technology is not enough. Had Marco Polo carried all the instruments of the Western orchestra to the Chinese court, it is extremely unlikely that Chinese musicians, accustomed to a pentatonic scale, would have been able to make effective use of these new resources for a very long time. The floundering in musical composition after the turn of the century which still persists today in electronic music (particularly "tone color music"), demonstrates the need for extensive experimentation with new materials.

The situation is far more severe when film or video as an abstract medium is considered. Film has existed for only a short time and the capacity for its effective abstract use dates (with rare exceptions) from the advent of computers and video. Vision, more central to our survival than hearing, has adapted to our normal environment more completely, and the visual materials appropriate for artistic use lie concealed within the capacities of new technology which can be used to synthesize these effects. Note that, for example, "dissonance" is a consequence of the occurrence of two pitched sounds, while visual dissonance seldom occurs in nature.

II: A VASTLY ACCELERATED EVOLUTIONARY DEVELOPMENT

Consider the mythical Chinese composer who is suddenly presented with the resources of a Western orchestra with seven-tone major and minor scales and the twelve-tone equal-temperament system. Suppose his intuition, steeped in the traditions of a five-tone system, were presented with the following tools:

a) A theory of perception which provided him with a description of the figured bass system appropriate for Western twentieth century music or twelve-tone music, etc., which selection is based upon a set of tests which uses him as a subject and measures his perception and preferences in use of materials.

b) A method of notating music (a description) in which it is necessary to specify only the attributes of the sounds and sound sequences and the relations and transformations which connect them. The specification would be extraordinarily economical in terms of the symbols used and hierarchical in structure so that sequences of sequences of sounds could be inter-related like the sequences of sounds and the individual sounds. The synthesis of a composition from the description would be automatic and immediate.

c) The basic attributes which are available for use with the system would derive from perception tests. The choice of attributes which can be used in the system would then be circumscribed by these basic attributes so that (a) all patterns that could be described would be perceptibly distinct; (b) all perceptibly distinct patterns could be represented; (c) a change in any symbol in the description would cause as much disturbance in the perceived pattern as a similar change in any other.

d) The composer could listen to the result of one of his compositions and provide the system with feedback of the form "I like this," "This makes sense," "I don't like this," or "This doesn't make sense" and the system would automatically alter the description so that the composer receives the desired result.

e) Similarly, the system would provide feedback to the artist by exposing those properties of the description which characterize his preferences. For example, a composer could ask the system to describe (in the given notation language) an existing composition he likes. He could then provide feedback to the composition synthesized from the resulting description until the perceived result is equivalent to the composition being put into the description language. Thus, he could do an analysis by synthesis and use the results to produce new work.

f) This entire system could be used to reliably incorporate materials from his own musical tradition into the syntax which is based on the new materials.

Such tools might provide our mythical Chinese composer with the means for rapidly passing through decades of experimentation and technical evolution.

III: CHARACTERISTICS OF THE SYSTEM

The tools outlined above now exist. They have been applied to the materials and practices of many Eastern as well as Western musical cultures and have produced surprisingly accurate predictions. New musical materials and equipment for realizing them have been produced and the results are well understood and ready for use. Additional applications to the perception of spoken speech and vision have been made, and visual and acoustical illusions predicted and produced.

The principal interest here is the application to the generation of a new abstract art form using film and video patterns which should be at least as compelling and powerful in psychological effect as music. This (although independently valid) is to be combined with music in a symbiotic manner to produce an integrated result. This, we contend, is possible in a very short period of time by using the tools outlined above.

Every perceptible visual and auditory pattern can be represented in the description language proposed. All intelligible and 'only' intelligible patterns can be represented in this language. This definition of "intelligibility" derives from tests performed directly on the 'artist himself.' The language is maximally efficient in that only perceptually significant 'attributes' of the pattern are represented by its symbols. This description, therefore, is vastly different in kind from a musical score (which is a set of instructions to a performer) and from a computer graphics program for producing images (which is a set of instructions to a machine for imitating a human drawing pictures). It is possible to program a computer to synthesize an entire film (or painting or choreography or musical composition) from a relatively short description in this language. Another program could, with the assistance of an artist who "teaches" the computer systems, analyze a film, dance or musical composition, that is, represent it by a statement (sequence of symbols) in this language. The computer thus can "learn" from an artist to analyze his individual perceptual processes and judgements.

The theory of perception, which forms the underpinnings of these methods provides the artist with information comparable to that possessed by the civil engineer and architect pertaining to the availability, strength and variety of materials. The rest of the system forms a powerful tool for rapid experimentation and simulation of works of art. This simulation can proceed, in a continuous manner, from one in which few details are specified to one in which every detail has been selected by the artist.

IV: VISUAL ANALOGUES OF MUSIC

The basic elements of human perception which have provided elements for the construction of musical forms in all cultures have included "acoustic dissonance" (arising from beats between harmonics, etc.), "tonality" (arising from difference tones), rhythm or pulse (deriving from the need to organize duration), the ordering of pitch (higher or lower), loudness, timbre, density of sound, etc.

Similar properties of vision exist. Those least well known and investigated are those attributes of visual texture and its change against time which produce psychological and physiological effects analogous to "acoustic dissonance" and its concomitant sensations of "tension" and "relaxation." Acoustic dissonance derives from the receipt of impulses which are in the same order of frequency as the refractory period of the auditory nerves. Similar, and more powerful, visual effects occur when there is an interference pattern with the refractory period of the optic nerves or with the alpha rhythm of the brain. These have been observed with strobe light usage in electroencephalograph experiments and similar effects also occur when motion picture frames are changed at the rate of about ten per second. They also occur when viewing certain moving Moire patterns, patterns from diffraction gratings, flicker effects, and have occurred in randomly generated computer produced image sequences (e.g. "Pixillations" by Knowlton & Schwartz – Bell Labs). Such effects, however, have not been thoroughly understood or controlled. This, however, is no longer the case. Note that the interfering families of curves forming a Moire pattern need vary very little in order to produce blinding interference patterns. This resembles a musical dissonance, in which the frequency of the tones forming a chord vary little, but the total effect is far more than the combination of component tones. Similar analogues to tonality, timbre, etc., exist but are too lengthy for discussion here.

Rhythm or pulse has also rarely been effectively used in film or video. The structure of rhythmic perception which effects the concomitant powerful effects of anticipation, syncopation, etc. is now

well understood. These can be produced visually by a great many means which include, size and brightness variations, texture variations and color variations, blending (dissonance changes), etc. Although almost no examples exist in film or video, demonstrations in a psychology laboratory can easily be constructed.

V: SPECIAL EQUIPMENT

A unique musical instrument has been designed and partially built which is capable of both experimental and performance use (c.f. Fig. 1). Its capabilities are immense and directly relate to the results produced by applications of the above theories to date. Not only can it simulate the music of any culture and musical materials not yet extant, but is controlled by a keyboard carefully designed for the convenience and intuitions of musicians. This same keyboard system (when connected to a mini-computer and graphics display) may be used to control the interactive development of an abstract animated film or video tape (or also to animate choreography). This equipment has been designed and awaits application to the production of film, video and other art forms.

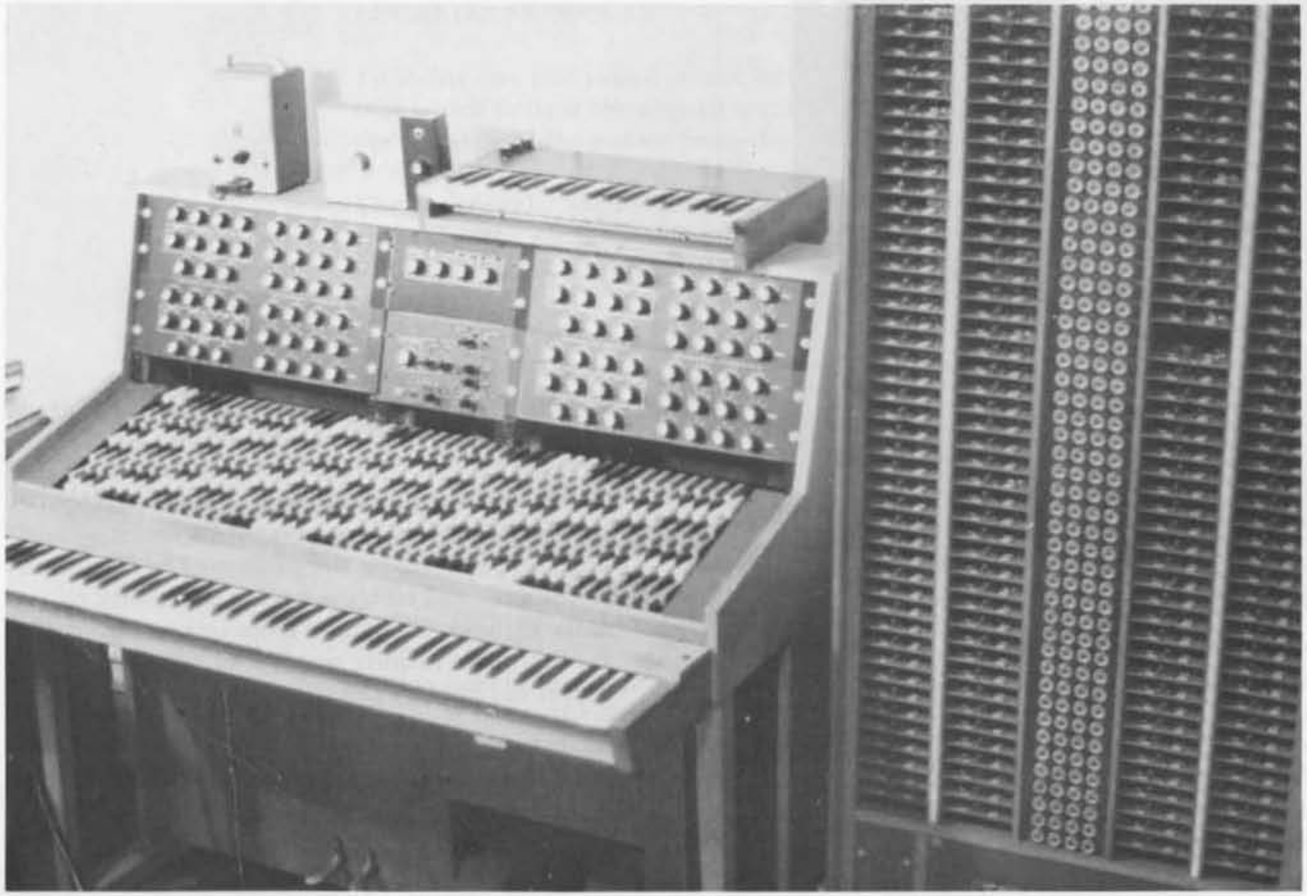


Figure 1
Rothenberg's keyboard used for composing visual music.

JOHN CHOWNING

Born 1934 in Salem, N. J. Received B. Mus. degree in Composition from Wittenberg University in 1959 after military service. Studied composition in Paris for three years with Nadia Boulanger. Received doctorate in composition in 1966 from Stanford University, where he studied with Leland Smith. Set up a computer music program at Stanford in 1964 with help of Max Matthews and Bell Telephone Laboratories. Currently teaches music theory and computer-sound synthesis and composition at Stanford's Department of Music.

John Chowning playing **Turenas (1972),**
a computer generated four channel audio tape.

"When we think of two different sounds - for example, the trumpet and the drum - we think of two different sources for those sounds...... But there must be a common timbral characteristic to all sound, and I want to find it. Imagine a sphere, on the surface of which are all sounds - and imagine having the ability to move through the sphere from one sound to another in an infinite number of ways .... that is the kind of situation I envisage."

John Chowning in an interview
with Max Wyman, in the
Vancouver Sun, Nov. 30, '71.

The Simulation of Moving Sound Sources

ABSTRACT

A digital computer was used to generate four channels of information which are recorded on a tape recorder. The computer program provides control over the apparent location and movement of a synthesized sound in an illusory acoustical space. The method controls the distribution and amplitude of direct and reverberant signals between the loudspeakers to provide the angular and distance information and introduces a Doppler shift to enhance velocity information.

The intent of this paper is to give some focus to the problem of synthesizing a sound source in an illusory space, and in particular a moving sound source, by defining a technique with which reasonably convincing spatial images can be produced.

LOCALIZATION CUES

To locate any real sound source in an enclosed space the listener requires two kinds of information: that which defines the angular location of the source relative to the listener, and that which defines the distance of the source from the listener.

The cues for the angular location are 1) the different arrival time or delay of the signal at the two ears when the source is not centered before or behind the listener, and 2) the pressure-level differences of high-frequency energy at the two ears resulting from the shadow effect of the head when the source is not centered.[1]

The cues to the distance of a source from a listener are 1) the ratio of the direct energy to the indirect or reverberant energy where the intensity of the direct sound reaching the listener falls off more sharply with distance than does the reverberant sound, and 2) the loss of low-intensity frequency components of a sound with increasing distance from the listener.

SIMULATION OF CUES

The following defines the configuration of loudspeakers and listener and the means by which the angular location and the distance cues may be simulated.

In this system four loudspeakers are placed so that they form the corners of a square, the perimeter of which forms the inner boundary of an illusory acoustical space as shown in Fig. 1. The listener is located inside this boundary as close to the center as possible. Since the localization cues are computed for the listener who is an equal distance from the four loudspeakers, there will be a geometric distortion of the spatial image for any other listener depending on his distance from the center. In the case of stereo simulation, the relative location of the listener to loudspeakers 1 and 2 is assumed (Fig. 1).

As in normal stereophonic and four-channel listening, the precise location of the listener is not known, which means, therefore, that any cues to location of a source which are dependent upon delay, phase, and orientation of the listener's head are inappropriate. The cue to angular location must be introduced by a changing energy ratio of the direct signal applied to a loudspeaker pair.

As shown in Fig. 1, the 360-degree space is divided into the four quadrants where each pair of loudspeakers are at an angle of 90 degrees relative to the listener. An obvious means of changing the ratio of the direct signal for the moving sound source S is to make the energy applied to the loudspeaker pairs proportional to the angle of displacement. Thus,

$$\% \text{ signal } CH_1 = \sqrt{1 - \theta/\theta_{max}}$$

and

$$\% \text{ signal } CH_2 = \sqrt{\theta/\theta_{max}}$$

where $\theta_{max} = 90$ degrees . As the source moves into the adjoining quadrant, CH_2 and CH_3 are substituted for CH_1 and CH_2, respectively.

It may be, however, that in simulating the location of a single source with two virtual sources, a non-linear function might tend to "fill the hole" between the loudspeakers and de-emphasize the regions near the loudspeakers. Such a function can be produced by making the energy ratio proportional to the tangent of the angle. Thus,

$$\% \text{ signal } CH_1 = \sqrt{1 - ½ [1 + \tan (\theta - \theta_{max}/2)]}$$

$$\% \text{ signal } CH_2 = \sqrt{½ [1 + \tan (\theta - \theta_{max}/2)]}$$

In order to simulate the distance cue one must synthesize and control the reverberant signal as well as the direct signal such that the intensity of the direct signal decreases more with distance than does the reverberant signal. The amplitude of the direct signal is proportional to 1/distance. As an example, assume the distance from the listener to the point midway between two loudspeakers to be 'L' (see Fig. 1); we wish to simulate a source at a distance of 2L. The amplitude of the direct signal would be attenuated by 1/2.

It is assumed that in a small space the amplitude of the reverberant signal produced by a sound source at constant intensity but at varying distances from the listener changes little, but that in a large space it changes some. Therefore, in these experiments the amplitude of the reverberant signal is made proportional to $1/\sqrt{\text{distance}}$.

VELOCITY CUES

In the presence of a moving sound source, a listener receives velocity information from the rate of movement of the apparent source position and the shift in the frequency of the source due to the Doppler effect (radial velocity).

The simulation of the Doppler effect is achieved simply by computing the distance D from the sub-

ject to the apparent source and making change in frequency proportional to dD/dt.

REVERBERATION

As was noted above, reverberation is an essential part of the distance cue. Reverberation also supplies the "room information," giving general cues as to size, shape, and material construction. In simulating a sound source in an enclosed space, then, it is desirable for the artificial reverberation to surround the listener and to be spatially diffuse.

To achieve the surround effect and the diffuse quality each output channel has a reverberator with independent delays and gains.[3] In the simplest case some percent of the direct signal is scaled according to $1/\sqrt{\text{distance}}$ and passed to the reverberators equally. Their percent governs the overall reverberation time within the limits determined by the values of the delays and gains of the reverberators themselves.[3]

It should be noted, however, that if the reverberant signal were to be distributed equally to all channels for all apparent distances of the direct signal, at distances beyond the echo radius[4] the reverberation would tend to mask the direct signal and eliminate the cue for angular location. In order to overcome this deficiency, the reverberant energy is controlled in the following two ways: 1) global reverberation, i.e., that part of the overall reverberant signal which emanates equally from all channels, is proportional to (1/distance) $(1/\sqrt{\text{distance}})$ and 2) local reverberation, i.e., that part which is distributed between a speaker pair as is the direct signal, is proportional to (1–1/distance) $(1/\sqrt{\text{distance}})$. Thus, with increasing distance of the apparent source the reverberation becomes increasingly localized, compensating for the loss of direct signal energy. In fact, this may be a fair approximation of a real acoustical situation, for as the distance of sound source increases, the distance to a reflecting surface decreases, thereby giving the reverberation some directional emphasis.

PROGRAM CONTROL

For the purpose of sound synthesis a special computer program was written which is similar to those developed at Bell Telephone Laboratories.[5] The program and system allow up to four output channels at a 25-KHz sampling rate per channel. The output signals are recorded on a four-channel recorder-reproducer.

In order to generate the control functions for a moving sound source, a special subprogram was written. The program uses a CRT to display a square which defines the inner boundaries of the illusory space, and a double-jointed arm whose position can be read by the computer. When the arm is moved, a pointer displayed on the CRT moves in a corresponding manner. The user presses a button as he moves the arm and simultaneously a point trace of the movement is displayed on the screen. Since the points are plotted at a constant rate, their relative distance to each other indicates the velocity of the movement. The coordinates of the points are stored, the user types in a distance scale value for the Doppler shift, and the program then computes, displays, and stores the resulting control functions. It also allows the option for computing a geometric sound path . . . .

A diagram indicating the manner in which the above functions are applied in the sound synthesis program is shown in Fig. 2. The original signal (21) is frequency modulated (22) for Doppler shift. The output (23) is amplitude modulated (24) for distance of direct signal, 1/D. The signal (26) is then

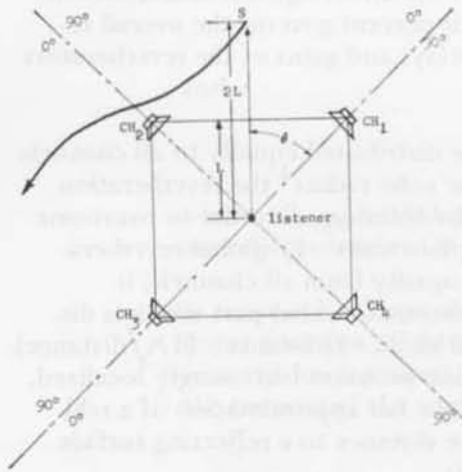


Figure 1: Configuration of loudspeakers defining illusory and listener space.

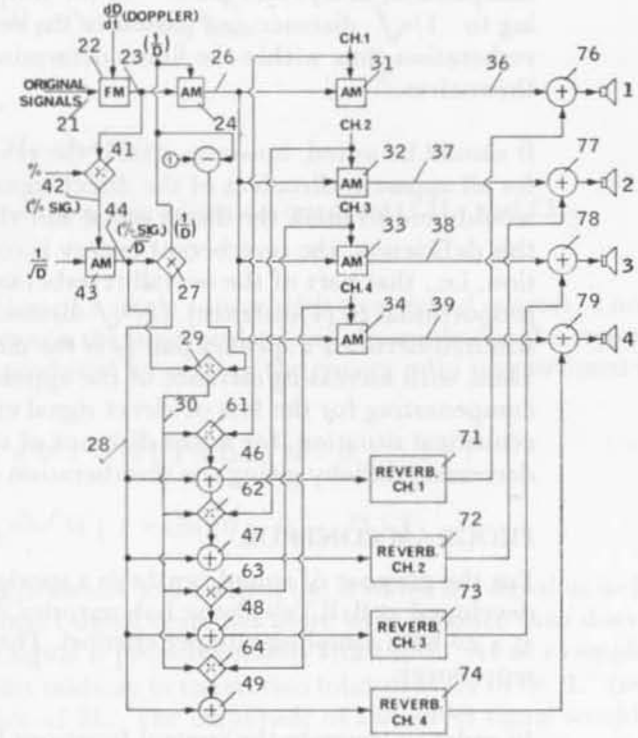


Figure 2: System used to process signal.

amplitude modulated (31-34) by the functions controlling angular location (CH_1-CH_4). The outputs (36-39) are passed through adders (76-79) and then to loudspeakers (1-4). * Thus far, the direct signal has been processed for frequency shift, distance, and angle.

The frequency-modulated signal (23) also takes another path to produce the reverberant signals. It is attenuated (41) by some percent to control all reverberation time. The output (42) is then amplitude modulated (43) for distance, $1/\sqrt{D}$. This output (44) is modulated (27) by the distance function and the output (28) becomes the percent of the signal to become global reverberation. The output (44) is also modulated (29) by the (1 – distance) function. This signal (30) is then distributed in angle according to the same functions (CH_1–CH_4) which control the direct signal and added (46-49) to the global part. These four signals are then reverberated (71-74) and added to the direct signal (76-79). Multiple input adders can be placed immediately before the reverberators (71-74) and also replace those before the final output (76-79) to allow the simultaneous movement of a number of independent sources where the circuit (Fig. 2) must be multiply defined only up to the reverberators and the final adders. This point is important because the reverberators cause the greatest expense, in computing time and memory, of the system.

SUMMARY

By using graphic input devices in conjunction with a powerful computer system a means has been developed by which an illusory sound source can be moved through an illusory acoustical space, allowing a great deal of flexibility and control. At some loss in flexibility but a gain in real-time control, the processing system can be rendered as an analog device. With some care in the design of the reverberators some number of independent channels of synthesized music or recorded music with a minimum of natural reverberation can be transformed into two or four channels where the location, static or dynamic, of each input channel can be independently controlled in an illusory environment which can have a large range of reverberant characteristics.

References:

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Extract from the Journal of the Audio Engineering Society, v. 19 (January 1971).

* It should be pointed out that the numerical representations of the waves are actually stored on a disk file and not converted to electrical energy and applied to the speakers until after the computation is completed.

Corporeal Sound Sculpture

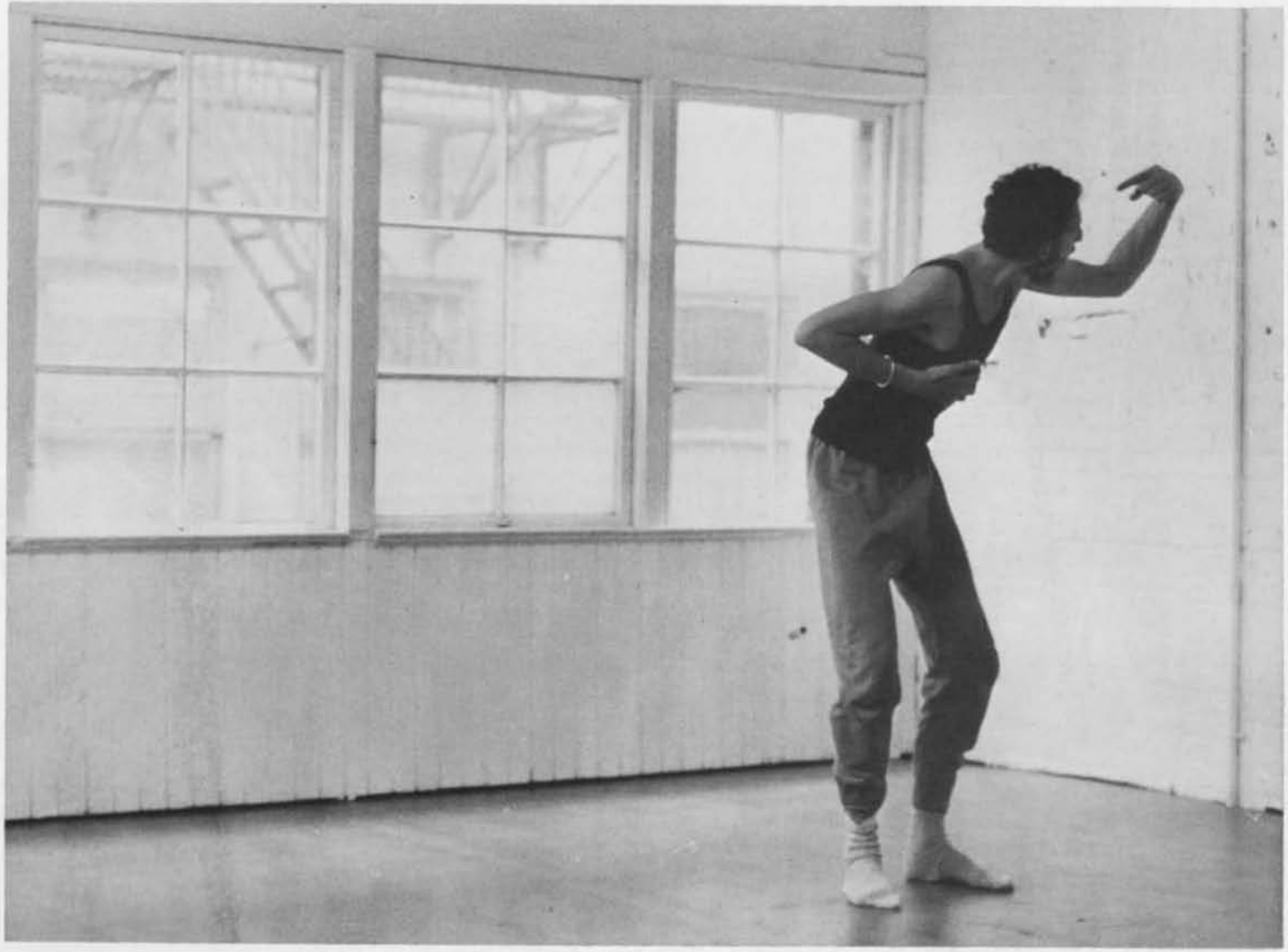
There are other avenues of significance in sound sculpture which basically utilize nothing more than the individual human organism.

In India, this has been an acknowledged discipline for millennia: the nada yogi Pandit Pran Nath is such a man.

In the liner notes to the only record album that Pran Nath has allowed to be made of his singing, La Monte Young commented that the elements which occur when Pran Nath sings "produce together a feeling so profound, so intensely moving, so much out of the very depths of the soul, that I am taken to a place far within myself – far back in time – to the essence of some basic spiritual truth that has somehow been preserved in this music." This latter comment, in one sense, serves to illustrate the significance of what can be done with just one's essence working with one's body. Sculpting vibration in space in time.

The artifact, the physical object on the tactile level is not necessary. One can begin a study of sound sculpture with exactly what one has at this moment. In a similar vein to that of Pran Nath, actor and director Corey Fischer, describes in the following essay the generative roots of his discipline's emergence into sound sculpture. This is then followed by a series of photographs taken during one of John Grayson's 'Sound Awareness Workshops'.

Pandit Pran Nath performing with La Monte Young and Marian Zazeela on Tambouras.



Corey Fischer in rehearsal.

COREY FISCHER

Transitions

The fact that our theatre company is working in a sound sculpture mileau says something about the changes that have occured in how a lot of us perceive and practice theatre.

Through most of the twentieth century, the psychological models at the basis of western theatre came from Freud and Stanislavski; the structural models were mostly literary: narrative plots, analyses of social behaviour, characters who were representative of societal pressures: the legacy of Chekov, Ibsen and Shaw handed down to Odets, Miller, Williams, Osborne, etc.

The first break with these models came from playwrights like Samuel Beckett and Eugene Ionesco. In their plays event followed event without causality. Their structures were more often cyclical rather than linear. Their characters were not "real people" in the sense of verisimilitude. Their language was paradoxical and extra-verbal.

The second break began to happen as the practitioners of what came to be the "new" theatre – Grotowski, the Becks, Paul Sills, Joe Chaiken, Peter Brook, etc. – began to look to the work of Artaud, Brecht, Jung, Reich, Levi-Strauss for a new orientation to the processes of theatre.

Thus, various aspects of theatre which had been left in the background but which, in fact, pre-date most of the concerns of "traditional" western theatre, began to emerge into the foreground. These aspects are: Theatre as 'event' (the whole genre of "Happenings"), Theatre as 'play' (most obvious in the work inspired by Viola Spolin's and Paul Sills' notion of theatre games and improvisation), Theatre as 'ritual' (the Living Theatre), Theatre as 'confrontation' (Grotowski), Theatre as 'process' (possibly the most common aspect in all current experimental theatre).

As our idea of the human psyche changed to accomodate a view of self as discontinuous, transformational and irrational, the Stanislavskian notions of "the through line" or "spine" of a character no longer fit. From the work of Spolin, Joe Chaiken, Paul Sills, etc., the concept of the transformation, as a tool for the actor, emerged. The actor on the stage, as the actor in the street, was free to switch masks as often as he needed.

As we began to examine our bodies and voices, we discovered a vast potential of non-verbal interaction. In many cases the lines between theatre, therapy and ritual became hard to draw. What is essential here is simply that for the first time in a great while, the actor was once again freed from the straight-jacket of socialized behaviour (which is not to say that he won't find other straight-jackets). The actor no longer had to convince the audience that they weren't there, that he was not an actor, that this was not a theatre. He could begin to explore the act of performance and at the same time reveal the process of his exploration. He didn't have to "act natural." He was free to take on the shapes of animals, angels and demons, free to talk in tongues.

This brings me back around to the idea of performing CROW, a "theatre-piece" as part of a sound sculpture exhibition. Sound. Sculpture. The body is a resonator. Voice is breath released as vibration. The texts are templates, labyrinths, pathways, patterns through which we articulate that vibration, that energy. As voices fill the space, shapes are formed. Our faces, our mouths, tongues, throats, spines and stomachs echo those shapes. We are sculpting on both sides of our corporal boundries. We are feeling our voices and hearing their echos. The feelings awaken associations; the score gives us a path through them.

These colliding and connecting elements – sound, movement, feeling, text – forge, in the act of performance, something which exists only while it is being made and is not complete unless witnessed. Today, words like Art, Theatre, Religion, Music, Sculpture, are melting. We can't contain them with closed definitions any more. Sculpture can move and make sounds and destroy itself and transform itself and transform the witness. So can theatre. Sculpture is tactile, audial, olfactory, visual: it works with the senses. So does theatre. Whatever you want to call these various activities – theatre, music, dance, painting – they all come down to playing with, and articulating energy, and they form, in relationship to each other, a continuum of changing materials, dynamics, structuring, etc. They exist – not to be analyzed, abstracted, or otherwise fragmented – but to be experienced.

JOHN GRAYSON

John Grayson was born in Windsor, Ontario in 1943. During the mid-sixties he worked under artists Harry Partch and Charles Mattox. Since then he has been constructing various sonorous sculptures and environments at a farm on Vancouver Island.

discovering the Breath

Vocal and body sound conducting: touch is the cue.

Vocal and body sound conducting: touch is the cue.

Discovering the energy in a resonating body.

Developing the ears, touch, and vestibular consciousness: spending a day blindfolded.

Finding lost sounds, forgotten sounds.

concentrating attending listening

Listening *for the touch of consummate reality.*

PART IV

This section provides a cursory look at practical, largely tried and tested, illustrative descriptions of innovative and creative applications of everyday materials for use in the creation of sound sculpture. The guidelines, examples, methods and ideas presented by the various contributors will be of use not only to those well along the path, but to any individual just beginning to explore & experiment.

WILLIAM COLVIG

This essay shows how a harmonically rich ensemble of sounds can be inexpensively made through the imaginative utilization of common, everyday contemporary materials. There are literally thousands of shapes and kinds of materials all around us, products and by-products of our industrial culture which never before have been available to man and which are waiting to be "discovered" and used as vehicles for sound sculpture.

A Western Gamelan

The collection of tuned metal elements making up the Southeast-Asian Gamelan makes lovely music as several people play on it. The composer Lou Harrison and I decided to make our own Western Gamelan (cf. fig. 1) based in general on the traditional ones but not copying anything for the sake of authenticity. Our primary consideration was to make beautiful sound; our primary purpose to build a usable musical instrument for which new serious music could be composed. (Eye appeal is very important also in musical instruments, so that was kept very much in mind when designing our Gamelan.) Various pentatonic (5-toned) scales are used much in the world and can be tuned with perfect harmony, whereas our western "tempered" scale is only actually in tune in its octaves. The Gamelan can make use of unusual tunings very nicely since it can be tuned near perfection then cannot be played "out-of-tune." The principal elements in the traditional Gamelans are cast metal bars with bamboo resonators and round, bell-sounding, "upside-down" bronze gongs, all suspended with leather for free vibration. Using Western materials, our Gamelan is a "happy hybrid" of pipes (cf. fig. 2) and bars and metal resonators (cf. fig. 3,4) and rubber mountings for the pipes (cf. fig. 5) and wooden stands (cf. fig. 6,7) to hold everything up. The only "traditional" materials used are leather for mounting the bars (cf. fig. 8) and, of course, wood.

Here are a few notes on construction: The steel upper "soprano bells" are 1-inch trade-size thinwall electrical conduit; the "tenor bells," 1-¼-inch trade-size electrical conduit. The aluminum "sopranos" are 1-inch outside-diameter furniture tubing and the "tenors" are aluminum tube sized the same as the 1-¼-inch electrical conduit (cf. fig. 7). The bars for the lower tones are all aluminum with sizes varying as found in a scrap metal store (cf. fig. 8). Mostly they are about 7.2 mm (¼-inch) thick and 90 mm (3½-inches) wide. The resonators for the bars are soldered together "billy cans," i.e., No. 10 food cans available at any restaurant back door (176 mm high, 156 mm dia.) (cf. fig. 4). The bottom is left on the bottom can. The tone will not sustain if the coupling is too tight (resonator too perfectly tuned). All pipes and bars are mounted at their nodal points – 22½% of their lengths from each end – the pipes with medical rubber tubing on nails (cf. fig. 5) and the bars hung on leather shoe laces from 20d size double-headed construction nail "posts" (cf. fig. 8). Lumber used: ¼-inch plywood and ¾-inch pine boards. The beaters for playing: ¼-inch x 15-inch dowel sticks with 2-inch dia., ¾-inch thick round wooden heads padded with stretched-on slices of motorcycle tube.

The tuning of any instrument is determined by its use. In this case, our instrument was built to be composed for by a composer so its tuning was specified by that composer (Lou Harrison). Certainly it could be made with "sharps and flats" and all tuned up out-of-tune Western style in 12 equal tones so you could play "Stormy Weather" on it. Why bother? We already have pianos and marimbaphones, etc., to play our favorite tunes on. Marvellous new (to us) sound sensations can be achieved by trying different musical modes in "just intonation," the expression used for rational tuning. Once a mode is set up, you can either improvise or seriously compose your music for it. Although the pentatonic scheme is basically the most harmonious, other tones can be filled in with good results too. The Western basic 7-tone C-Major scale, justly tuned, is a good place to start with musical experimentation. We tuned ours in D, based on A-440. The pentatonic involved here is D-E-F sharp-A-B and the ratios simply:

A$\downarrow$ D, 3:2; A$\downarrow$ E, 4:3; D$\uparrow$ F-sharp, 4:5; F-sharp $\uparrow$B, 3:4.

Metallic sounds are complicated, so are difficult to tune by ear. A modern electronic tool gives our modern Gamelan precise vibrations perhaps never before possible. The oscilloscope pictures 3 sine waves against 2 or whatever and the builder files away until the waves stay put (cf. fig. 9). If a bar or tube is cut too short, bolts, nuts, and washers work fine for lowering the pitch (cf. fig. 10). The above ratios are given as used with the oscilloscope. The "fill-in" tones for a complete "major" scale are G and C-sharp tuned D G, 3:4 and F-sharp C-sharp, 2:3. What we come out with here (with our "major" scale sounding much like the D-major scale as sung by a choir) is "Ptolemy's Diatonic Syntonon" or "stretched diatonic" scale. Its note-to-note ratios work out:

$$\text{D}\ \frac{9}{8}\ \ \text{E}\ \frac{10}{9}\ \ \text{F sharp}\ \frac{16}{15}\ \ \text{G}\ \frac{9}{8}\ \ \text{A}\ \frac{10}{9}\ \ \text{B}\ \frac{9}{8}\ \ \text{C sharp}\ \frac{16}{15}\ \ \text{D}$$

Starting with A-440 vibrations per second,

$$\frac{10}{9} \times 440 = 488\frac{8}{9} \text{ for B,}\quad \frac{9}{8} \times 488\frac{8}{9} = 550 \text{ for C sharp, etc.}$$

Very good minor pentatonic modes are available from this scale starting from F-sharp, while a pelog-type pentatonic mode starts from B. Changing ratios for one or more tones will make other modes to play in. We have made one for some compositions that first sounds very strange then becomes quite glamorous upon further hearing. Using the 7th and 11th harmonics we call it the "7-11" scale. Its pentatonic:

$$\text{Tone-tone ratios}\qquad \text{A}\ \frac{7}{6}\ \ \text{"C"}\ \frac{8}{7}\ \ \text{D}\ \frac{9}{8}\ \ \text{E}\ \frac{11}{9}\ \ \text{"G"}\ \frac{12}{11}\ \ \text{A}$$

	$\frac{1}{1}$	$\frac{7}{6}$	$\frac{4}{3}$	$\frac{3}{2}$	$\frac{11}{6}$	$\frac{2}{1}$
Ratios to base tone						
	$\frac{6}{6}$	$\frac{7}{6}$	$\frac{8}{6}$	$\frac{9}{6}$	$\frac{11}{6}$	$\frac{12}{6}$

Experimenting with many different modes can be done easily on a monochord, then the monochord can be used to tune any instrument, including the Gamelan. The oscilloscope is recommended, however, for transferring the monochord tones to metallophone elements.

Our bars range from A-55 (787 mm long) to D-293-1/3 (294 mm long). Our pipes, both steel and aluminum sets, go from A-220 (636 mm) to B-977-1/9 (479 mm) on the big ones and A-440 (636 mm) to E-2607-11/27 (251 mm) on the smaller ones.

Much experimenting can be done with developing the Western Gamelan. The tubes could be resonated (here bulk may be a problem); the tubes could be bars instead and resonated (that's a celeste); use other metal such as brass; wood (xylophone), etc.; the big bars (slabs) could be adjusted in width to give consonant overtones (5th – 3:2, or octave – 2:1, most desirable); all sorts of arrangements could be made to mount the elements and embellish them for visual beauty.

While building our very own repertoire for our Gamelan let us not forget the very extensive existing Asian one. An evening's program could include Balinese and Javanese selections and something from the Philippines.

Figure 1 *Part of Bill Colvig's 'Western Gamelan'.*

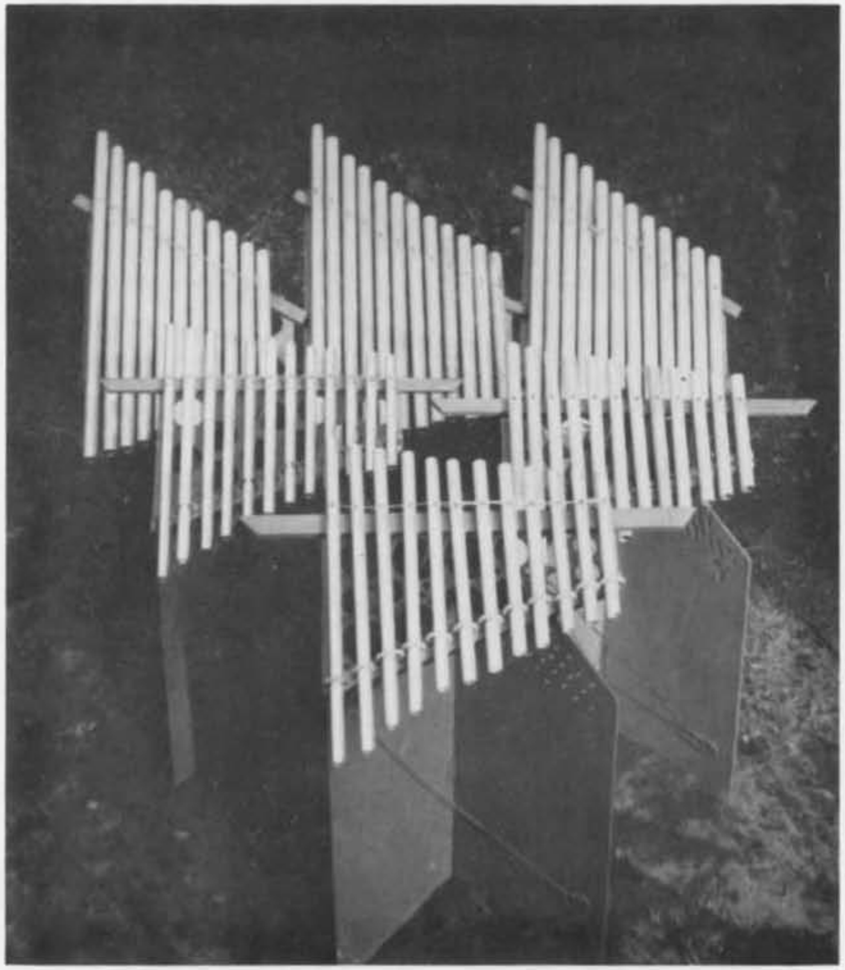
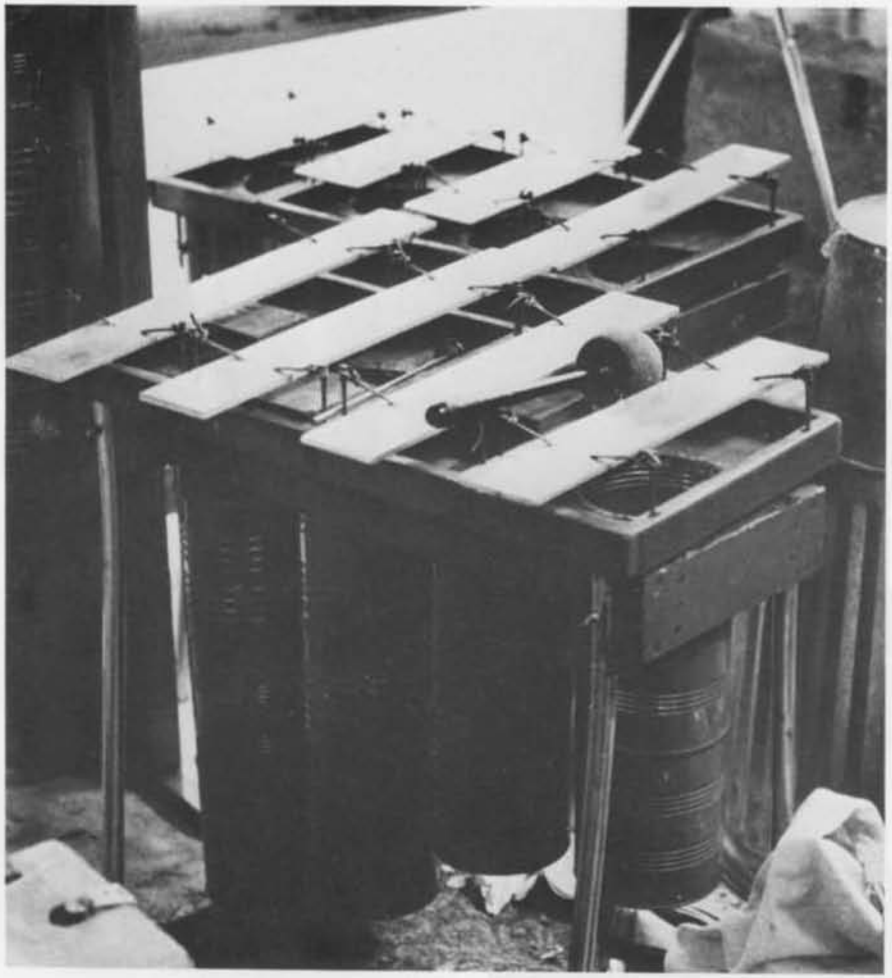


Figure 2
Part of Bill Colvig's 'Western Gamelan'.

Figure 3
Bill Colvig plays some of the deep bass tones of his 'Western Gamelan'.



← *Figure 4*
Detail of the mid-range bass tones.

Figure 5
This is a typical base showing the rubber tubing upon which are mounted the tuned metal tubes. This base is, in turn, placed upon the wooden stand shown in Figure 6.

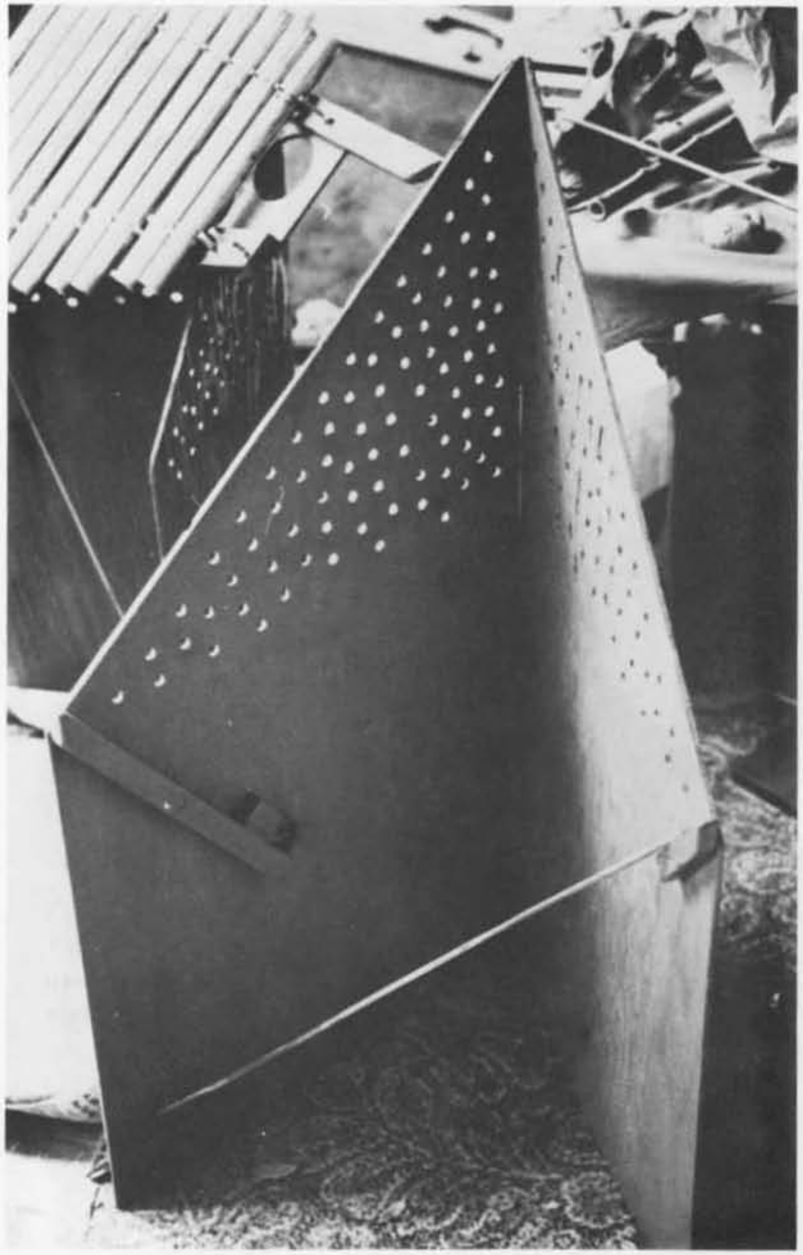


Figure 6
A typical wooden stand. The little holes are for improved sound dispersal.

Figure 7 A typical section of pipes (with a rubber mallet resting on the centre top of the pipes) sitting on the wooden stand as shown in figure 6.

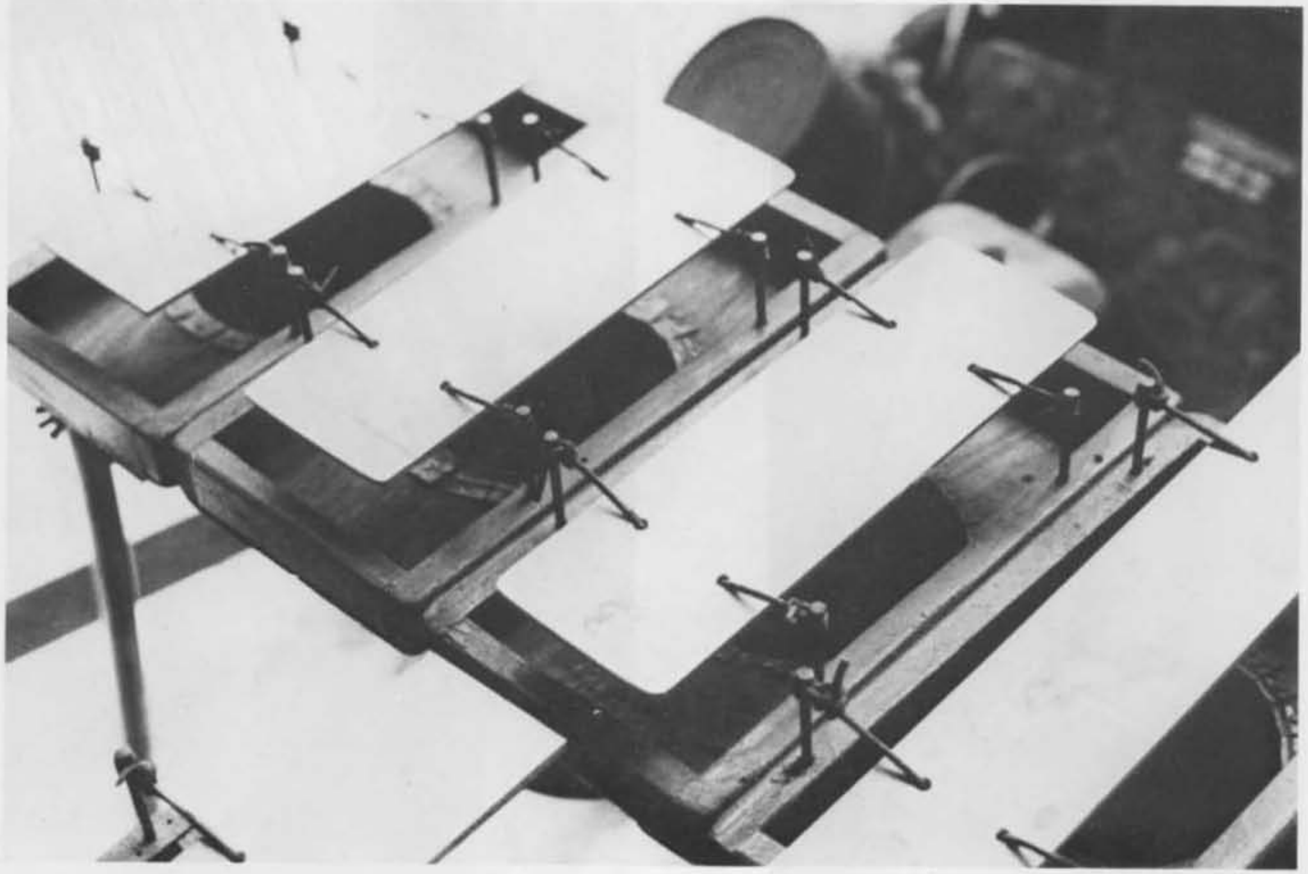
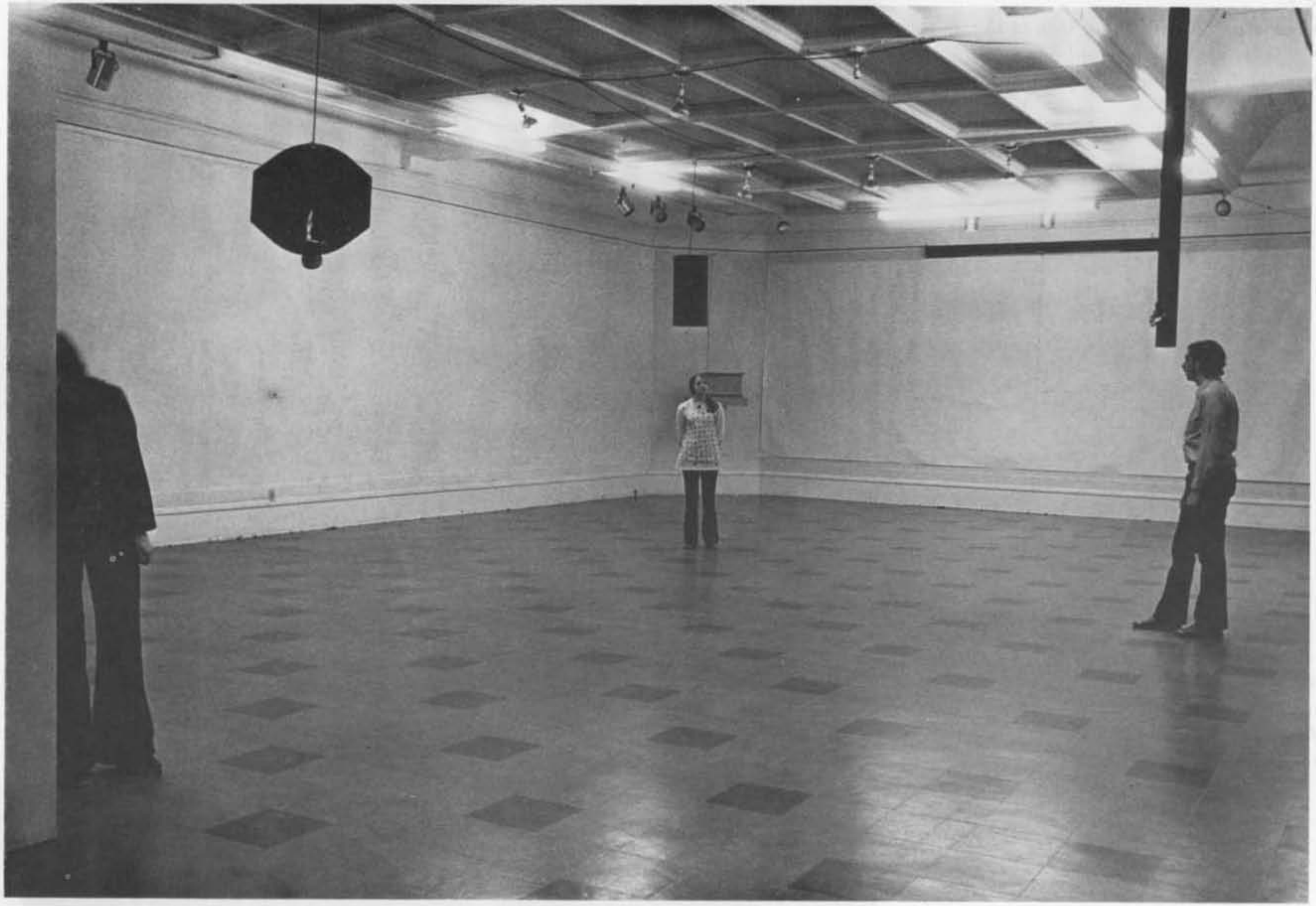


Figure 8
Leather hiking boot shoe-laces tied to the nails are used for mounting the metal bars.

Figure 9
The oscilloscope controls are seen in the upper left corner. The microphone is seen to the left of the metal pipes.

Figure 10
Various bolts, nuts and washers are used for lowering the pitch of a metal tube.



Sounding Space

a self-generating, participant-modulated electronic/acoustical environmental piece, a work created for the Vancouver Art Gallery.

PAUL EARLS

Sounding Space: Drawing Room Music

"Sounding Space" is a self-generating, participant-modulated electronic/acoustical environmental piece which allows a space to generate some of its own musical potential, as well as allowing participants the rare opportunity to hear and modify the standing waveforms of a room. It represents a new development in the field of environmental art and demonstrates the creative application of conventional equipment and knowledge.

The idea for "Sounding Space" grew from two other projects recently realized at the M.I.T. Center for Advanced Visual Studies, with which I have been associated since 1969. In March, 1972, I completed two sets of audio tapes of electronic music for the Colombian installation of a collaborative fire piece entitled "Flame Orchard." A version of that work is in this exhibition, and is the work of the Director of the M.I.T. Center, Gyorgy Kepes.

"Flame Orchard" consists of a sound-activated field of fire which makes use of the resonant characteristics of enclosed spaces (much like sound boxes), coupled with the vibrational patterns of fixed plates to generate Chalday figures and Bessel functions which modify the activity of the living flames. They change shape, color, size, or personality in a living relationship with the music.

Music for this piece required some real-time electronic composition, as I soon learned that the external environment (temperature, humidity, and barometric pressure) could significantly alter the response of the boxes, and that theoretical calculations were not valid under all conditions. Indeed, the flames themselves modified the environment and changed the characteristics over time. My music, to be effective, was pre-compositionally limited to those events determined by the physical characteristics of the system, including its eccentricities and inter-action with its environment.

The linkage of musical sound with spatial position and movement was at the heart of the "Sound Floor" devised for the 'Dialogue for the Senses' exhibition opening the Wadsworth Athenium's Tactile Gallery in Hartford, Connecticut. That unit, conceived and realized after a suggestion by Gyorgy Kepes, was completed only one week prior to the first presentation of "Sounding Space." It is part of an environment for unsighted artistic perception, and consists of specially constructed musical instruments placed in a false floor which are activated by stepping through the area. Timbral systems are linked through chess moves. Here my role as a composer was in the design of fruitful sequential and simultaneous possible combinations which were made available for participant assembly. To play the

instruments both hearing and total physical timed movement were employed, linking the ancient relationships of music and dance in a more contemporaneous field effect structure. It also brought to my mind the concept of a person's position generating or modifying a sound.

The theoretical basis of "Sounding Space" is the additive effect of acoustical and electrical feedback. If any complex signal, such as speech, is repetitively re-recorded by miking its amplified delayed playback, the resonant characteristics of the room, and to a lesser extent the equipment involved, will act as a comb filter, quickly rendering the words incomprehensible and transforming the original signal into an amplitude and harmonic-partial modulated pitch cluster.

The process of delayed feedback has interesting and powerful aesthetic conceptual implications. Norbert Wiener speaks of it as "a method of controlling a system by reinserting into the system results of its past performance . . . if the information which proceeds backwards from the performance is able to change the general method and pattern of performance, we have a process which may well be called learning."

Only a handful of artists have explored this area of real-time living with your own past: Alvin Lucier and Karlheintz Stockhausen are composers who have done so, and James Seawright's TV works are impressive examples. "Sounding Space" also relies on both the physical process and its philosophical position.

My work uses the familiarly shunned phenomenon of real-time microphone feedback as the primary sound generating system. As is well known, any coupling of an open microphone with the amplification of its own pickup will generate an oscillation in the electronic circuitry of those systems which quickly goes out of control: it howls and squeals to the discomfort of all. The tuned circuits are resonated beyond their load limits if the amplification continues, as the signal is perpetually additive. This effect has its counterpart in conventional musical instruments: when the sensitive resonances of stringed instruments are over-stimulated buzz and 'wolf' tones appear. Some Rock performers have made a limited use of microphone feedback for 'weird,' special effects.

Standard formulae for obtaining the spectra of room resonances (Eigentones, natural oscillations) in a rectangular space predict, for instance, that a 6x9x12-foot room will have approximately twelve such oscillations at 100 Hz., 18 at 175 Hz., 25 around 250 Hz., and over 30 at 280 Hz., with the number steadily increasing as the frequency bandwidth rises. "Sounding Space" concentrates on the lower frequencies, by the use of filters and resonators.

The Eigentones of M.I.T.'s Hayden Art Gallery were combined with circuitry oscillations to produce the first installation of "Sounding Space" for two weeks in May, 1972. All of the primary audio signals in the room were resonated by controlled microphone feedback. Two other optional sound sources were included in the M.I.T. installation: a voice-activated sampling of electronic music produced on a EMS Synthi-I, and the amplification of participant singing or talking. Neither are necessary for the success of the system. They were included to provide an extra measure of participation and as a means of triggering and encouraging potential vibrational modes. Only the voice system is used in the Vancouver installation.

Each of the microphones in the room is dually coupled to a specific resonator and loudspeaker spread throughout the room. These resonators include organ pipes, hollow open cylinders, and parabolic missle covers. In the Hayden Gallery one mike was attached to a sail that moved it across differing organ pipes by air currents. One microphone is placed in a hollow partition at head level with a grilled access so that people can sing or speak into it. It feeds a loudspeaker at another end of the room. All of the other microphones are suspended from the ceiling and are not directly accessible to the participants.

The standing waveforms existing in the area betweeen the microphones and loudspeakers determine the fundamental pitch clusters sounded. The actual partial sounded of each series is selected by the microphone resonantors and other signals existent in the room, including the activity of all the other channels and added signals, such as singing, speech, handclaps, etc. Most significant is the presence or absence of a body at a crucial nodal point of a standing wave. At M.I.T., a modern dance class spent four hours profitably using the system to generate their own musically choreographed movement.

The electronic multipliers shown in the logic diagram are indispensible to the success of the system, as they control the amplifiers and prevent the continuous locking-on of any single pitch. These circuits output the electronic product of two input signals, retaining the arithmetic property of outputting zero (no signal) when either input is zero. In this case, one of the multiplier inputs is a variable low-frequency (.2 - 2 Hz.) sine wave, producing a continuous smooth swelling and fading of the pitches, as the sinusoidal alteration of the oscillator is acting as an automatic gain controller. When the polarity of the controlling sine wave changes, another partial of the same series sounds. Thus each microphone-loudspeaker produces at least two differing, alternating pitches. Other pitches are sounded when other conditions change. At the first installation I counted sixteen different pitches occurring within twenty seconds. A minute change in the oscillating rate has a tremendous effect upon the system, as some modes take longer to settle into oscillation than others. The Vancouver installation allows participant influence upon the oscillator/multipliers.

Changing atmospheric and crowd conditions during the course of any day not only produce new results, but also transform the system so that the same dial readings will not produce identical results when the room is empty and other conditions are as close to identical as possible at the start of the day. Is some kind of automatic, electronic learning taking place? The room remains stable only when empty, when up to 40 seconds can pass without an exact repetition of events.

This incongruity perhaps derives from the total cybernetic qualities of the system: all the sonic activity and waveform patterns are inter-active, and a change in any part of the system alters the entire unit which in turn provides new data for the system. The event has true evolution capabilities, and, in my own mind, it takes on a real and living personality during the course of an exhibition. Closing it down the final day is like an act of homicide.

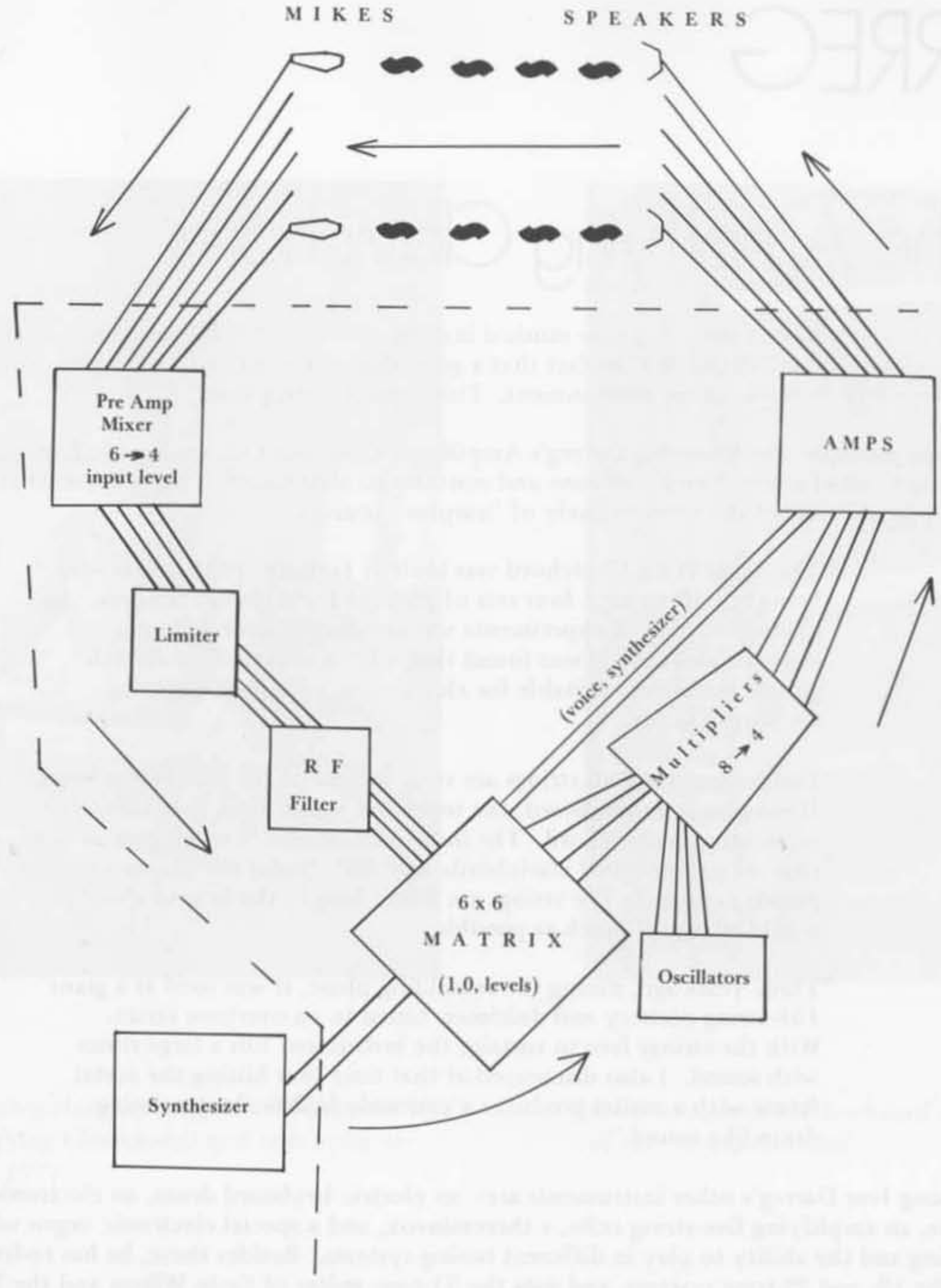
As mentioned above, all of the resonators and filters are adjusted to suppress high frequencies. It is rare that a pitch above 400 Hz. (middle 'c' is around 260 Hz.) is produced. The majority of the pitches should be between 30 and 300 Hz. The limiters are set to take effect just before the hard clipping level, and they output a near-triangular waveform (the closest acoustical instrument equivalent is a clarinet, but they're not normally used in that range). The net effect is of a complex, slowly evolving work for a choir of trombones which mysteriously move about the space.

The ear easily accepts a relatively high volume of sound in the bass region, as the ear is most inefficient there, particularly if the amplitude and slope of the signal are gradual. Even though the actual decibel level is relatively high (up to 100 db) in the room, the combination of smooth amplitude and frequency waveforms (sine to delta) moving through a harmonic array of low frequencies (even though some series are 'dissonant' with others) can produce a pleasing sonic environment. Perhaps these principles can be used where intrusive noise is a problem, not by trying to eliminate the noise, but transforming it to a format more acceptable.

The appearance of the environment is calculated to enhance its quiet, monochromatic, contemplative oasis-like qualities for leisured exploration. The controlled lighting is simple, emphasizing the different shadow values of the resonators, loudspeakers, and microphones. They are the only visible pieces of equipment. Their cords are tacked to the walls and ceiling leading to the viscera of the system hidden in another room, something like a Wizard of Oz arrangement, with the magic concealed and the room itself a mystery. Yet the real sound-producing instruments are truly only the microphones and loudspeakers, and the performers are the participants.

The equipment used is a hybrid of high quality home hi-fi units and a few special laboratory items. At M.I.T., AKG condenser microphones, a Sony mixer/preamp, Marantz amplifiers, and Bose 901 loudspeakers were lined with some relatively inexpensive and easily crafted circuits. The matrix mixer is not a generally available piece of equipment, though it is extremely useful for any electronic presentation, and I have made up a special 4x4 unit for the Vancouver installation. Voltage-controlled oscillators and multipliers are, in a different format, basic synthesizer modules. I adapt my units from circuits used at the M.I.T. Research Laboratory of Electronics, as well as building my own.

The possibilities for the use of this system in urban environments, private homes, and theater/dance are obvious and are being explored. It offers a composer another way in which he can simultaneously assume a generous, inviting stance to a public while retaining his specialized and sophisticated role with others who become, like him, performers, creators, and audience.



SOUNDING SPACE SCHEMATIC

IVOR DARREG

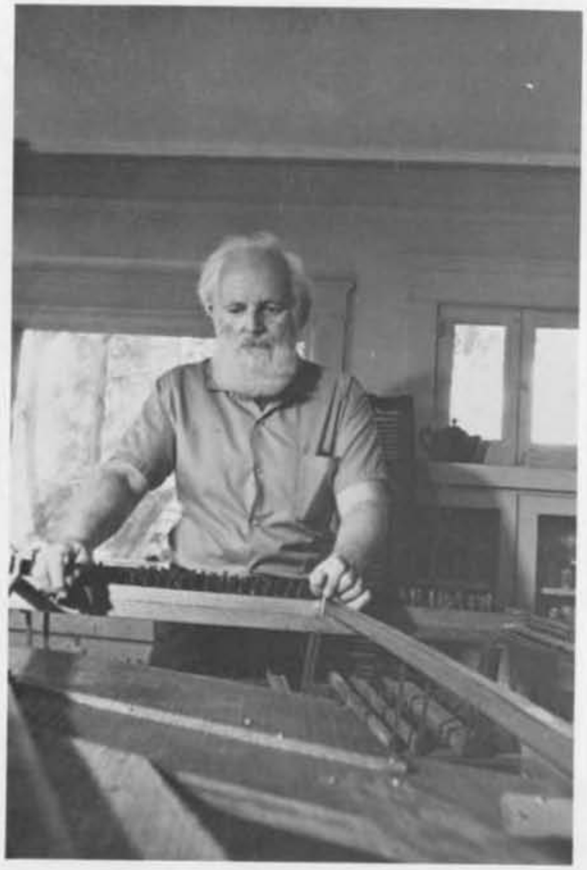
The Amplifying Clavichord

Ivor Darreg has been inventing new musical instruments since the thirties. One aspect of this area of his endeavours well illustrates the fact that a good deal can be done in sound by using only what is immediately available in the environment. This is what Darreg does.

As one example, the frame for Darreg's Amplifying Clavichord shown here (c.f. Page 177) is constructed out of a reinforced bedframe and contains an abundance of parts from what would normally be considered the most unlikely of "surplus" sources.

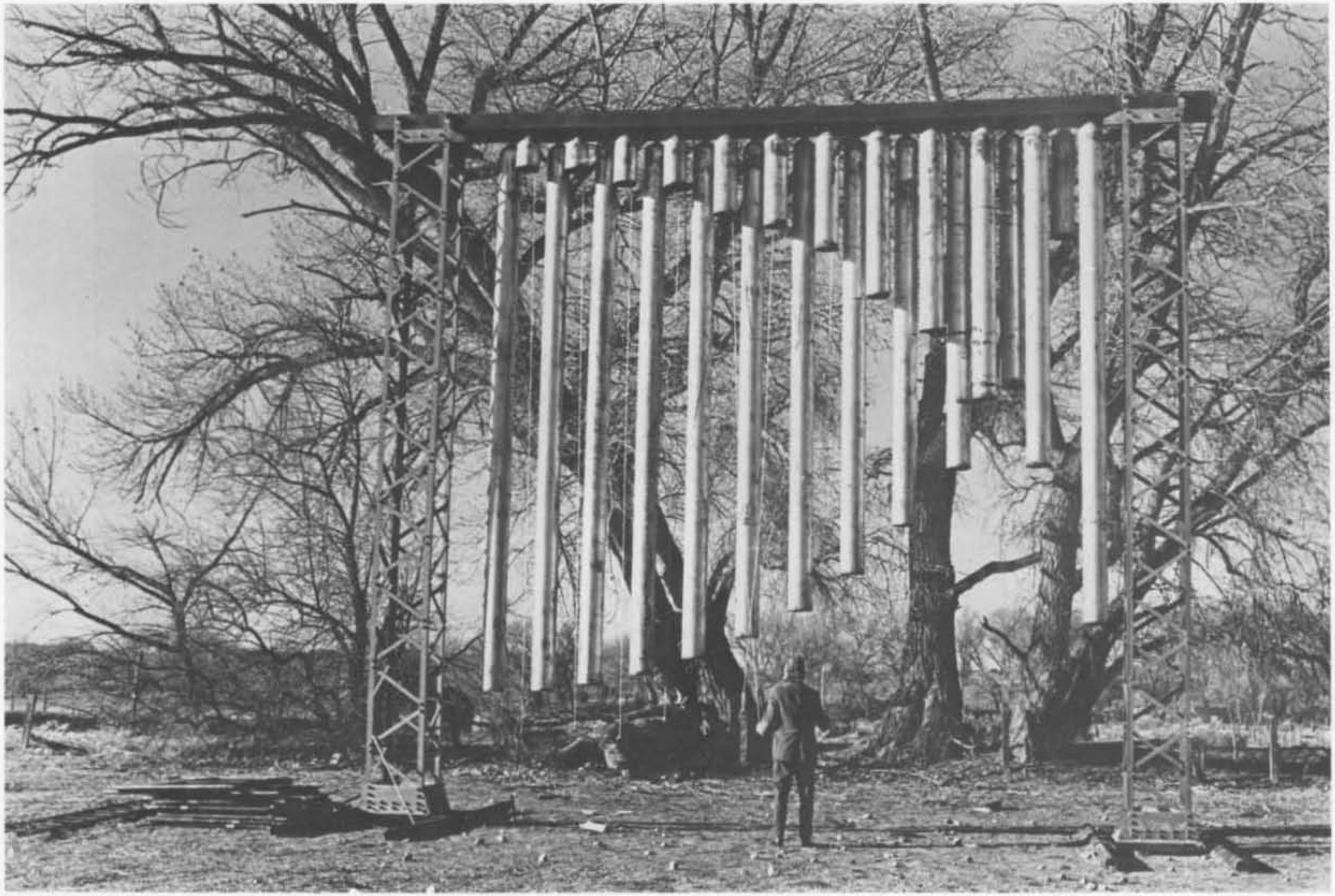
> **"The Amplifying Clavichord was built in January, 1940 and is now being rebuilt to have four sets of pickups for different timbres. An extensive series of experiments was conducted with different types of pickups - it was found that what works well on electric guitars is not very suitable for clavichords, though it might be for harpsichords.**
>
> **"The tangents and all strings are steel instead of the traditional brass. Having no soundingboard, the tones last longer than they do in the conventional clavichord. The individual vibrato is much greater than that on conventional clavichords, and fully under the player's expressive control. The strings are 8-feet long in the bass to avoid would strings as much as possible.**
>
> **"Three years ago, during the rebuilding phase, it was used as a giant 158-string psaltery and dulcimer, tuned to an overtone series. With the strings free to sustain, the instrument fills a large room with sound. I also discovered at that time that hitting the metal frame with a mallet produces a curiously hollow, long-echoing drum-like sound."**

Among Ivor Darreg's other instruments are: an electric keyboard drum, an electronic keyboard oboe, an amplifying five-string cello, a thereminvox, and a special electronic organ with automatic tuning and the ability to play in different tuning-systems. Besides these, he has re-fretted guitars to the 19- and 22-tone systems, and uses the 31-tone guitar of Ervin Wilson and the 19-tone Schafer Undevigintivox.



Ivor Darreg standing with his 'Megapsalterion' (Amplifying Clavichord) as it was being re-built in 1971.

Rear section of the keyboard action of the Megapsalterion.



A Musical Carillon *by Tony Price*

Tony Price

A Musical Carillon

This sound sculpture stands on a remote section of scrub land not far from Santa Fe, New Mexico. On page 178 it is being played with clappers activated by ropes attached to them, which strike the metal cylinders. The wind also plays it. The cylinders can be manually swung against each other.

Part of the artist's concept includes the eventual mounting of solenoid strikers which he would operate from a control board from the nearest back porch over a half-mile away. The metal cylinders are unique since they were gathered from the scrap yard of the Los Alamos Atomic Energy Testing Ground.

A Concert of Factory Siren & Steam Whistles*

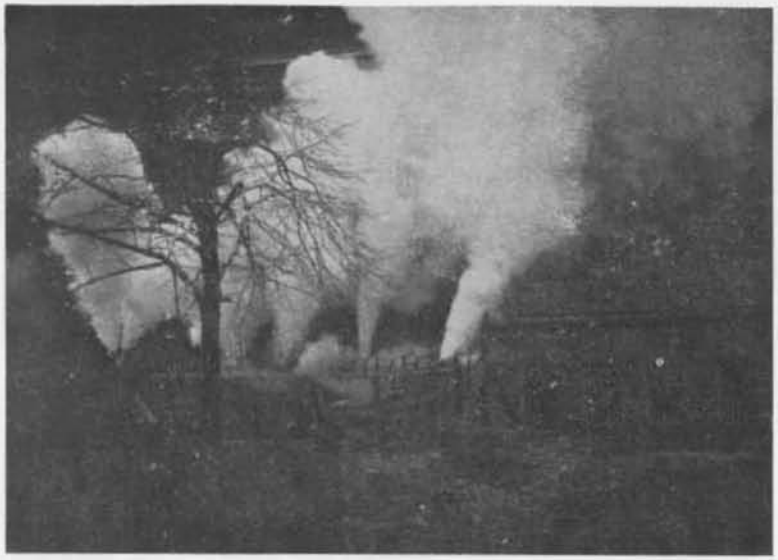
A new idea for proletarian music developed in post revolutionary U.S.S.R. during the early 1920's. "The new music had to embrace all the noises of the mechanical age, the rhythm of the machine, the din of the great city and the factory, the whirring of driving-belts, the clattering of motors, and the shrill notes of motor-horns.

"Therefore, the Bolshevists very soon proceeded to construct special noise instruments, to form noise orchestras, to give the public a 'real new music' instead of the usual old bourgeois, individualistic 'patch-work,' and in this way to prepare the collective soul for the revelation of the holiest. They imitated all conceivable sounds from industry and technology and united them in peculiar fugues, in which a whole world of noise deafened the ear. In increasingly extended forms the new 'machine music' made itself felt, and soon noise symphonies, noise operas, and noise festive performances were composed. Performances of this kind were carried out with a seriousness and a devotion which resemble religious mysteries."

The 'symphony of factory whistles' which "was used by preference at all great communist festivals, was due to the untiring revolutionary poets, Gastev and Maiakovski. They pointed out that proletarian music should no longer be confined to one narrow room, but that its audience should be the population of a whole district. The factory whistle was, in their opinion, best adapted to be the new and prodominant orchestral instrument, for its tone could be heard by whole quarters and remind the proletariat of its real home, the factory. It was not long before theoretical discussions were put into practice; as early as 1918 experiments with factory whistle symphonies of this kind were tried in Petersburg and later in Nizhni-Novgorod. But the first performance on a large scale took place in Baku on 7th November 1922. The foghorns of the whole Caspian Fleet, all the factory sirens, two batteries of artillery, several infantry regiments, a machine-gun section, real hydroplanes, and finally choirs in which all the spectators joined, took part in this performance. The festival is said to have been very impressive; it is not surprising that this music could be heard far beyond the walls of the town of Baku."

*From: 'The Mind and Face of Bolshevism' by R. Fulop-Millen, G.P. Putnam and Sons, London & New York, 1927

The conductor of the concert of Factory Sirens and Steam Whistles.



The steam whistles in action. The conductor can be seen on the roof.

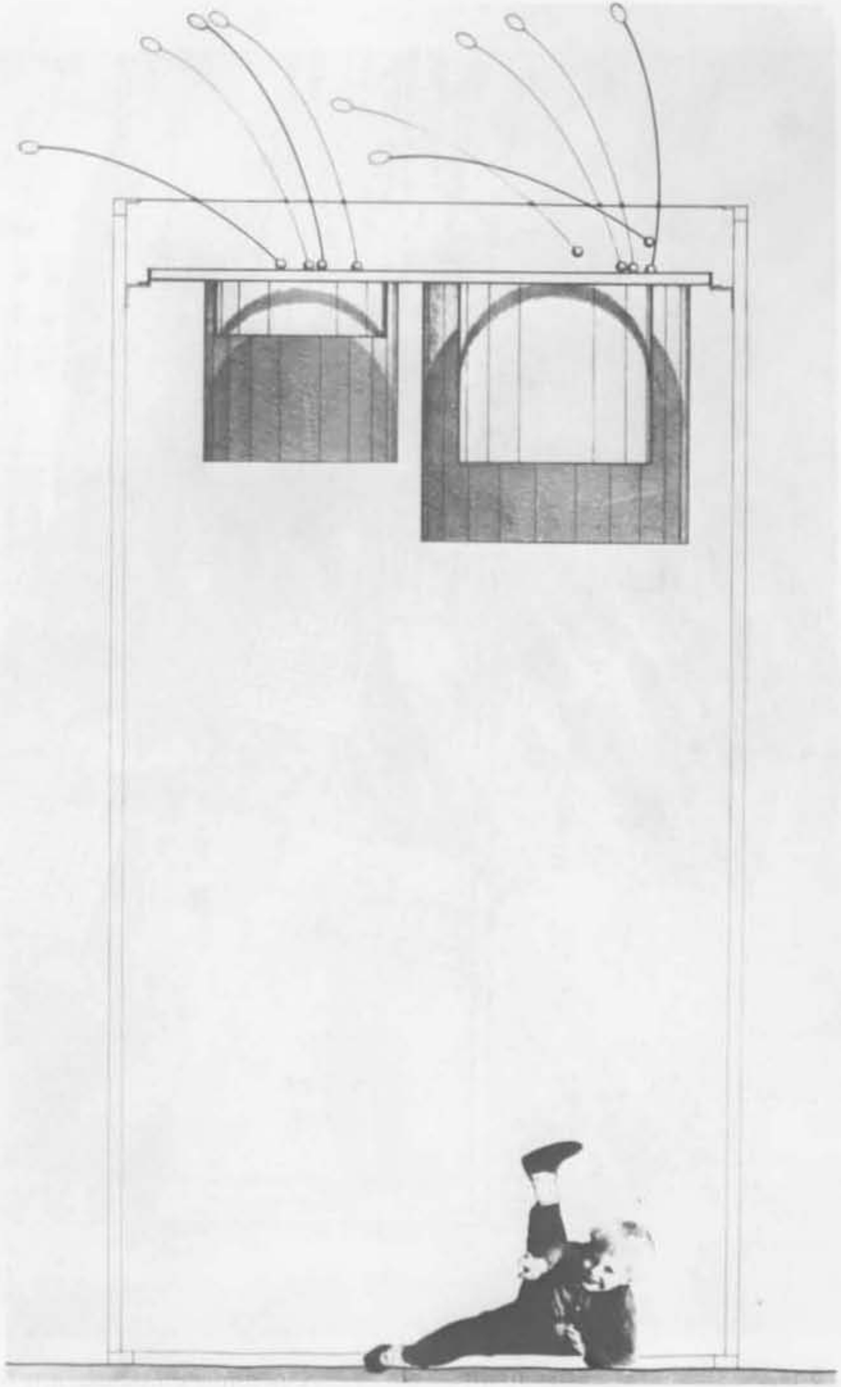
Luis Frangella with a subsection assembly of 'Rain Music II' (drumheads, aluminum, metal frame, plexiglass, rubber beaters).

Luis Frangella

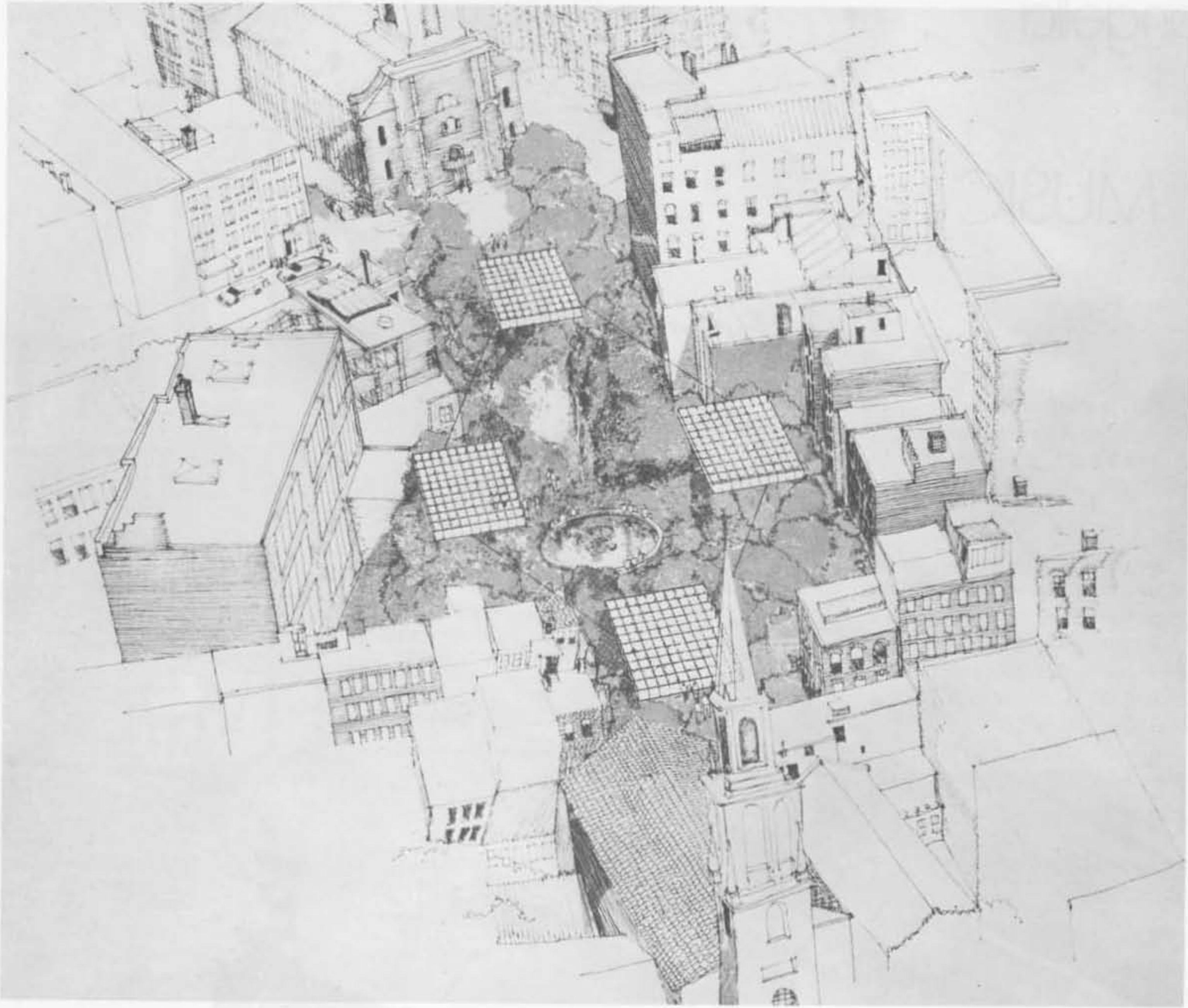
RAIN MUSIC II

Luis Frangella -an Argentine artist currently working with M.I.T.'s Centre of Advanced Visual Studies- has developed many interesting large scale sound sculptures. This is one of them. Rain Music II serves as a good example of a large scale environmental sound sculpture.

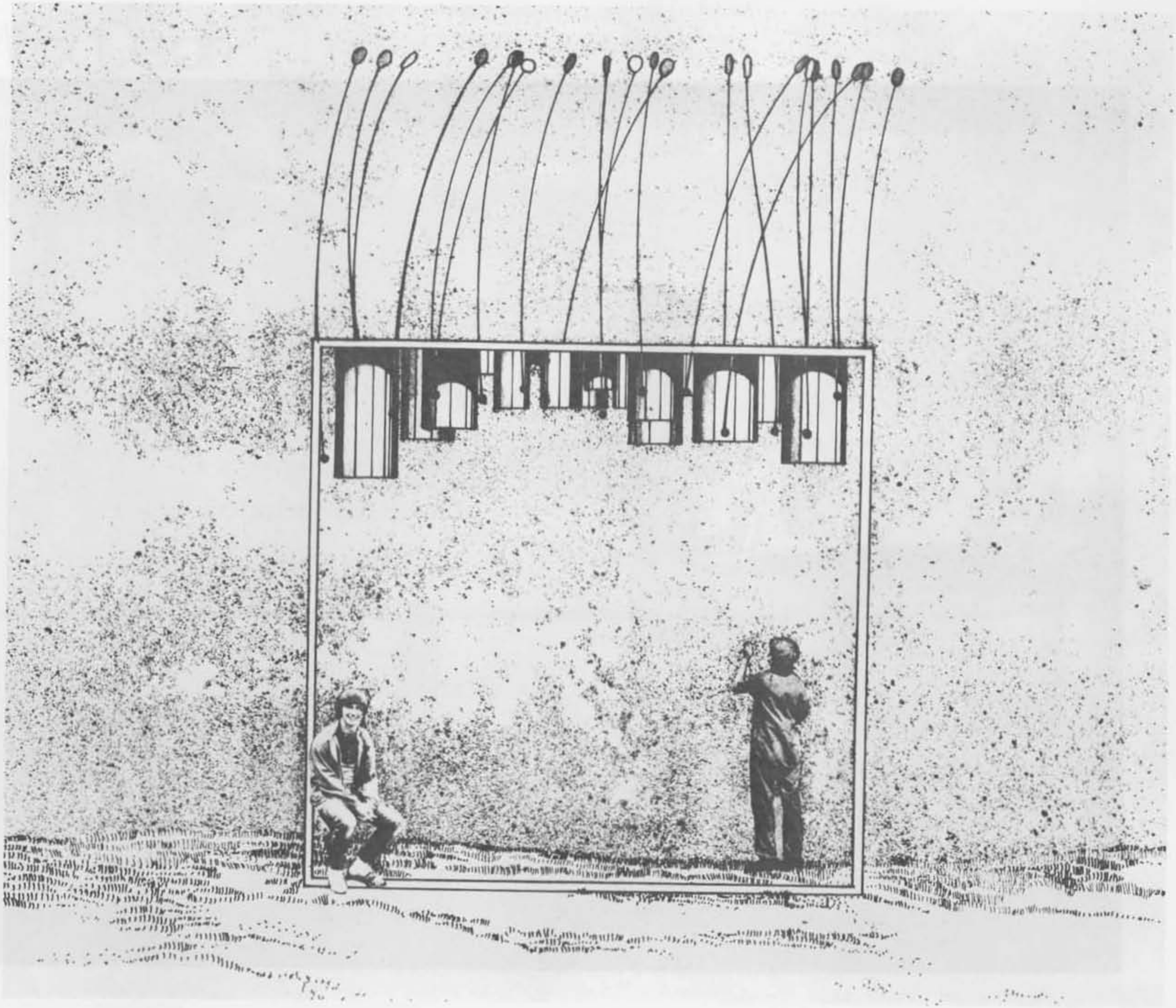
Rain Music II is a series of drums (shown in detail on this and the opposite page) arranged in the shape of a roof to be placed in a quiet place in a city (c.f. page 184). The moving elements mounted above the drums transform the impact of rain drops or the movement of the wind into kinetic energy causing the elements to strike the tuned drums with varying amounts of force.



Rain Music II, sub section.



A proposed installation for 'Rain Music II'. Each large square is a roof like canopy and contains 110 modules as shown on pages 182 and 183.



A variation on 'Rain Music II' by Luis Frangella

Max Dean

Max Dean

SOUND SCULPTURE

GENERAL DESCRIPTION

A wooden cube containing a mechanism capable of cutting the top off the cube. The mechanism is activated when the ambient sound reaches a specific level.

TECHNICAL DESCRIPTION

The mechanism within the cube consists of a central steel shaft supporting an electric chain saw and an electric motor. The centre shaft is anchored by a metal cross piece to which is attached a second electric motor. The saw, positioned so that the blade is parallel with the top of the cube, is mounted on a metal bracket attached to the centre shaft.

The mechanism is triggered by a voice operated relay located in the stand. Upon activation both the chain saw and an electric motor start. The motor, coupled by a chain to the metal bracket, pivots the saw drawing it through the wall about 4 inches from the top of the cube. When the blade is perpendicular with the side of the cube a contact switch turns off the motor while another switch starts the second motor. The second motor is coupled to the centre shaft and rotates the saw through the remaining three hundred and sixty degrees. When the saw returns to the starting point another pair of contact switches cut off the chain saw and electric motor.

After the piece is completed the mechanism is transferred from the cut cube, sealed inside a new cube, and replaced on the stand.

Max Dean *Cube: 2 x 2 x 2 feet. Stand: 2 x 2 x 3.5 feet.*

SOUND SEWAGE

'The depth and meaning of new sonic explorations are being obfuscated and neutralized by the vast and growing amounts of sound sewage permeating our environment. Recent studies show that sound pollution is causing many of us to lose aural acuity continuously. This has been shown not to be the case for people who have remained unexposed to western technological civilization. I wonder if a young professor or student of ethnomusicology, who has been raised in our sound polluted environment, would still be able to hear the subtle harmonic/inharmonic interplay that the Balinese musician hears and controls when playing in his traditional gamelan (musical ensemble).

Few artists are aware of a resolution passed by the International Music Council (UNESCO) in Paris in 1969, the first part of which reads:

'We denounce unanimously the intolerable infringement (through noise) of personal freedom and the right of everyone to silence.'

The sound sculptor today must take into account the danger of his work being destroyed by sound sewage.'

In ironic contrast to the preceding statement which I wrote in 1969 and which appeared in the journal Leonardo in 1970, the following letter was received from Colin Miles, an associate of the World Soundscape Project in April of 1973:

> "Some of the works at the recent sound sculpture show at the Vancouver Art Gallery were loud. We feel that the sound levels were potentially harmful to people's hearing. We therefore measured the intensity of the loudest works.

Baschet

Glass Trombone .... 68 - 78 dBA

Von Huene

Totem Tone 111 .... 84 - 100
Totem Tone V .... 86 - 98
Washboard Band .... 70 - 88
Rosebud Anunciator .... 89 - 95

Jacobs (large room)		
	highest	103 dBA
	lowest	76 dBA
Wah Wah room		92 (average)

"A reading in decibels on the 'A scale' most accurately measures the intensity of sound pressure on the human ear. On February 21, between 1 and 2 p.m. we measured the sound pressure levels of these works with a calibrated General Radio Sound Level meter. All measurements were taken at fifteen feet, although we found that the intensity was quite uniform in all parts of each room, due to reverberation. In the large Jacobs room the sound was continuous, slowly rising in volume until the peak was attained at 103 dBA. The loudest ten minute segment was in excess of 90 dBA. By comparison, the school children, outside on the sidewalk, waiting to visit the show, were exposed to a sound level between 68 and 76 dBA from passing traffic.

"If a light is intense, one can close one's eyelids or avert one's gaze in order to prevent damage to the retina. When one is exposed to intense sound one has no earlids to close and the ear suffers. One of the results of repeated exposure to loud sounds is hearing loss. It is generally accepted that prolonged exposure to sound intensity levels about 85 decibels will cause severe hearing loss and lifetime exposure to more than 70 decibels throughout the day will cause significant hearing loss. Nearly forty million North Americans have suffered enough hearing loss to require hearing aids and this is due to the noisy environment.

"In future audio-kinetic exhibitions we recommend that a sign be posted warning visitors about any sound levels which might cause temporary or permanent hearing loss."

It is interesting to note that in the case of the Totem Tones, Von Huene utilizes a typical low pressure wind system and pipes no different in energy output than those used in many church organs. The reason, in this case, for the difference in the decibel rating between Von Huene's works and a typical low pressure church organ (which presumably is not a danger to one's aural health) is the fact that the rooms in which these works were exhibited were of concrete and rock plaster - almost totally reflecting surfaces.

One can never be too careful in mounting and designing an adequate environment, especially since more than 22,000 people attended this exhibit in a 30 day period.

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A Request

If you are a sound sculptor and would like to be included in future expanded editions of this publication, please send us a typed description of your work containing information pertaining to: how it functions; materials used: special construction and/or acoustical techniques involved; and references, if any. Enclose good quality high contrast 8 x 10 inch photos or ink drawings of each piece. Every contributing artist will receive two complementary copies of each edition in which his work appears. Mail your material to: John Grayson, A.R.C. Publications, P.O. Box 3044, Vancouver, B.C., Canada V6B 3X5

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SOUND SCULPTURE is the first publication to deal completely with this new art form. It's a collection of over 30 articles and essays by an international cross section of Sound Sculptors who define and outline the field. It's also a definitive introduction to the history of Sound Sculpturing. Included are over 150 photographs and drawings illustrating the construction of such unusual projects as: how to build a Western Gamelan (Balanese 'orchestra'), examples of giant environmental Sound Sculptures, Sound Sculpture designed for a new "people's music," and so on. Harry Partch, Francois and Bernard Baschet, Stephan Von Huene, David Jacobs, John Chowning, Walter Wright, David Rothenberg, Lou Harrison, David Rosenboom, Bill Colvig, Corey Fischer, and R. Murray Schafer are just a few of the contributing artists.